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I. A REVIEW OF THE BIRDS OF CONNECTICUT, WITH REMARKS ON  
THEIR HABITS. BY C. HART MERRIAM.

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Read June 20, 1877.

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THE little State of Connecticut, forming, as it does, the southwestern corner of New England, and lying between the forty-first and forty-second parallels (exactly  $41^{\circ}$  to  $42^{\circ} 3' N.$ ), and extending, in an east and west direction, from the meridian  $71^{\circ} 55'$  to  $73^{\circ} 50'$  west longitude, contains an area of but 4,674 square miles. Nevertheless it is highly probable, so favorably is it situated, that no equal area in the country can boast a greater number of species of birds than may be found within its limits. Indeed, nearly half the total number of species in the United States have already been detected inside its borders, and it is certain that future investigation will decidedly increase this number.

Zoologically speaking, Connecticut belongs to that division of country known as the Alleghanian Fauna. Still, as Mr. Purdie has said,\* its southern border has an evident tinge of the Carolinian, and I may add that this "tinge" runs up the valley of the Connecticut River, extending completely through the State, and even into Massachusetts.

Some years ago Prof. A. E. Verrill stated that whenever such birds as the Crossbills, the Spruce Partridge and the Canada Jay "breed abundantly in any region, it may safely be considered as belonging to the Canadian Fauna."† With equal truth it may be said that whenever such birds as the Worm-eating, Blue-winged Yellow, and Hooded Warblers, together with the Large-billed Water Thrush and Yellow breasted Chat, *breed regularly and in considerable numbers*, the region may safely be included in the Carolinian Fauna. That these species are so found in southern Connecticut—notably about the mouth of the Connecticut River—is now too well known to need further confirmation.

The dividing lines between the several faunæ are always more or less irregular, and never very sharply defined. The distribution

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\* Am. Nat., vol. vii, No. 11, p. 693, Nov., 1873.

† Proceed. Essex Inst., vol. iii, p. 138. 1863.

of those species by which the different faunæ are distinguished, is unquestionably governed, in great measure (as shown by Professor Verrill),\* by the temperature *during the breeding season*, of the regions in which they commonly breed. Hence the dividing lines between faunæ do not follow, when placed on the chart, such smooth, regular curves as serve to represent the isothermal lines (which show the average temperature for the entire year), but more nearly coincide with lines drawn to indicate the average temperature during the months of April, May, and June,—the period in which the great majority of singing birds breed. It has been stated by Professor Verrill that “a line drawn upon the map of Eastern North America representing the mean temperature of 50° F., during these three months, will coincide with the southern boundary of the Canadian Fauna, as previously determined from the examination of the birds breeding in that sub-division. Another line representing the temperature of 65° will represent the southern boundary of the Alleghanian Fauna,”\* as distinguished from the Carolinian.

The fact that, during the thirty-four years that have elapsed since the publication of Linsley's “*Catalogue of the Birds of Connecticut*,” no enumeration of the birds of this State has appeared, is sufficient excuse for the present attempt. Moreover, the Connecticut Academy resolved, some time since, to publish a series of papers on the fauna of this State, and Professor Verrill did me the honor to request that I should prepare, as the first of this series, “A Review of the Birds of Connecticut,” which I have done as well as the limited time at my disposal would permit.

In the year 1861, Dr. William Wood, of East Windsor Hill, Conn., published, in the Hartford Times, a series of twenty-one admirable and most interesting articles on our “Birds of Prey,” and it is much to be regretted that he did not, in like manner, take up the remaining groups. A few brief notices of the occurrence of some of the rarer species within our limits have, from time to time, appeared in the American Naturalist and Bulletin of the Nuttall Ornithological Club, but nothing like a systematic list of the birds of the State has been attempted.

My object has not been to give the largest possible number of species, but to represent faithfully our true knowledge of the Avifauna of Connecticut. An acknowledged fault with most local lists is that their authors include, not only those species which have actually been detected, but also those which, from their occurrence

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\* Am. Jour. Sci. and Arts, vol. xli, p. 249, (Second Series,) 1866.

in neighboring districts, may, at some future time, be looked for with a degree of success directly proportionate to the ornitho-distributional knowledge of the writer. In the preparation of the following list I have scrupulously examined the evidence on which each species stands, and have rigorously excluded all those whose occurrence rests on insufficient proof.

In a note, under each genus or family, will be found those species which should, and probably do, occur, but which, owing to the small number of collectors in this State, have not as yet been detected. Information has been solicited from all, so far as I have been able to ascertain, who are familiar with our birds—whether active collectors or not—and I take this means of expressing my thanks and gratitude for the many favors received, believing, at the same time, that they should not be regarded as mere personal favors, but as real contributions to science, for in preparing this list I act but as the exponent of the present state of our knowledge concerning the birds of Connecticut. I am indebted to my friends, Mr. George Bird Grinnell, Mr. A. J. Dayan, Prof. Wm. D. Whitney, Dr. Wm. H. Hotchkiss, Mr. Thomas B. Osborne, Mr. E. B. Wilson, Dr. F. W. Hall, Walter R. Nichols, the Stadtmüller Brothers, Robert F. Morris, and Fred. Sumner Smith, for information relating to species found in the immediate vicinity of New Haven; to Capt. O. N. Brooks, of Faulkner's Island Light, for a list of the water birds of that portion of the Sound; to Messrs. W. W. Coe and John H. Sage, of Portland, Erwin I. Shores, of Suffield, and J. N. Clark, of Saybrook, Conn., for notes on the species observed in the Connecticut Valley; to Dr. William Wood, of East Windsor Hill, Conn., for valuable information on the time of occurrence and relative abundance of many of the rarer species—especially in regard to the Hawks and Owls; to Prof. G. Brown Goode, of Middletown, Conn., not only for throwing open for my inspection the cases of birds contained in the Museum of Wesleyan University, but also for laboriously searching the Museum Catalogue for records of the capture of the rarer species within the State; to Josiah G. Ely, Esq., for notes on the rarer species found about Lyme, New London County, Conn.; and to Drs. D. Crary and D. Crary, Jr., of Hartford, Conn., for information concerning the less common birds of that vicinity. To each of these gentlemen due credit is given under the species to which their notes pertain. I am also under obligations to Mr. Robert Ridgway, of the Smithsonian Institution, Dr. Thomas M. Brewer, of Boston, and Mr. William Brewster, of Cambridge, for the identification of birds and eggs, and for other information.



My thanks are especially due to W. W. Coe, John H. Sage, Erwin I. Shores, Thomas B. Osborne, Capt. O. N. Brooks, and the Stadtmüller Brothers, for placing their manuscript notes at my disposal; also, to Professors A. E. Verrill, Sidney I. Smith, and Franklin B. Dexter, for the use of books not in the College Library; and to Dr. William H. Hotchkiss for aid in the preparation of the special lists appended to this paper, as well as for much kindly assistance rendered from time to time during the progress of the work.

Numerous references have been made to the writings of others, and I hold myself responsible for all dates and statements of any kind, where the contrary is not expressly stated. Neither have quotations been omitted, when they seemed desirable, either for the value of the facts they contain, or for their antiquity; and, as a rule, I have taken pains to refer to the older and less accessible works, rather than to those with which we are all familiar.

Although Ornithology, as a science, is, in this country, of comparatively recent date, still that the birds of New England early attracted the attention of our forefathers is evident from their writings. In the year 1616, Capt. John Smith said that there were, in New England, "Eagles, Gripes, diuers sorts of Haukes, Cranes, Geese, Brants, Cormorants, Ducks, Sheldrakes, Teale, Meawes, Guls, Turkies, Diue-doppers, and many other sorts, whose names I knowe not."\* And a few years later (1622) one William Hilton writes that the land "*affords beasts of diuers sorts, and great flocks of Turkies, Quailles Pigeons and Patriges: many great lakes abounding with fish, fowls, Beuers and Otters. The sea affords us as great plenty of all excellent sorts of sea-fish, as the riuers and Iles doth varietie of wild fowle of most vseful sorts.*"† And there are numerous others of a like nature, some of which have been reproduced under the species to which they refer.

It is worthy of note that many birds once common along the coast, and some throughout the greater part of New England, are now either extremely rare or not to be met with at all within its limits, while a few species have unquestionably increased in numbers since the country has become settled. Among the former class may be mentioned the Great Auk (*Alca impennis*), the Crane (*Grus Canadensis*, and perhaps *G. Americana* also), the Swan (*Cygnus Americanus*, and perhaps *C. buccinator*), the Wild Turkey (*Meleagris gallopavo*), the Pinnated Grouse or Prairie Chicken (*Cupidonia cupido*),

\* A Description of New England, by Capt. John Smith. p. 16. 1616.

† New England's Trials. p. 14. 1622.

the Swallow-tailed Kite (*Nauclerus forficatus*), the Raven (*Corvus corax*) now common only in northern New England, the Mocking-bird (*Mimus polyglottus*), and many others. That these birds were common here two or three hundred years ago is clear from the numerous references to them in the writings of the time. And during this period many others have greatly decreased in numbers—such as the Pigeon (*Ectopistes migratoria*), Pileated Woodpecker (*Hylotomus pileatus*), black-birds, water fowl, and waders of all descriptions.\* The disappearance of some of these birds is readily accounted for by the advance of civilization with its concomitant evils—destruction of forests, increased use of fire arms, etc.—but in other cases the cause is less easily explained.

Few people, living away from the coast, have any idea that hundreds of thousands of birds are killed each year, during migrations, by flying against lighthouse towers. Capt. O. N. Brooks, of Faulkner's Island Light, tells me that between two and three hundred dead birds were picked up at the foot of the tower on the morning of May 16th, 1877, and that at the same time thousands of living ones stopped at the Island, devouring all the tender plants and newly sown seeds in his garden. During the same night about three hundred birds killed themselves against the light at the entrance of New Haven Bay, and the daily papers stated that over seven hundred were picked up on the decks of one of the New York steamers. When we take into consideration the number of light-houses and steamships along our whole coast it becomes clear that the number of birds that perish annually by this means is simply immense. Nearly all our common, and many rare, migrants are found among the dead, but the Maryland Yellow-throats (*Geothlypis trichas*) greatly predominate, constituting full one third of the total number examined. It is lamentable that this wholesale slaughter of our song-birds seems to be unavoidable.

The nomenclature and arrangement of species adopted in the present paper is that given in Coues' "Key to North American Birds," with such corrections as have since appeared in his "Birds of the Northwest" and elsewhere.

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\* See also an interesting article by J. A. Allen in Bull. Nutt. Ornith. Club, vol. i, No. 3. Sept. 1876.

- A. *General List, giving times of occurrence and relative abundance of the species; together with notes on the habits and distribution of some of the less common forms.*

Family, TURDIDÆ.

1. *Turdus migratorius* Linné. Robin.

An abundant summer resident; breeds abundantly, and several times during the season. A few winter. The summer residents arrive during the middle and latter part of February (Feb. 18, 1876; Feb. 27, 1875), and remain in considerable numbers till near the close of November.

2. *Turdus mustelinus* Gmelin. Wood Thrush.

A common summer resident; breeds. Arrives about May 3d (common before the 10th), remaining till October. Mr. John H. Sage, of Portland, Conn., informs me that he and Mr. J. N. Clark, and also Mr. W. W. Coe, have found its eggs "covered with fine black specks." Mr. Fred. Sumner Smith, of this city, has recently shown me a large egg of this species which is marked with a few small, brownish-red spots. On sending the egg to Dr. Brewer, I received the following: "The spots I never noticed before, but any egg, always excepting a woodpecker's, is liable to be marked by minute effusions of colored lymph of the parent, in its exclusion." Mr. Smith tells me that the nest, which contained these speckled eggs, was placed on a railway bridge, and within *six inches* of the rail. A number of trains pass daily over this bridge.

3. *Turdus Pallasi* Cabanis. Hermit Thrush.

Common during its migrations, particularly so in the fall. Arrives from the South before the middle of April (April 7, 1877, Coe; April 6, 1875, Sage; April 13, 1874, Sage; April 14, 1876, Osborne; April 16, 1877, April 19, 1875), remaining till early in May; on their return are with us from early in October till the latter part of November (Nov. 14, 18, 20, 1875). The woods abound with them during the middle and latter part of October.

4. *Turdus Swainsoni* Cabanis. Olive-backed Thrush.

Common during its migrations, but never so abundant as the last. It is met with in spring from May 10th to 26th, and in autumn from

Sept. 4th (1874, Hall) to Oct. 13th. In the fall it is not uncommonly found in flocks of a dozen or fifteen in low swampy woods where there is an abundance of undergrowth.

**4a. *Turdus Swainsoni*, var. *Aliciae* (Baird) Coues.** Gray-cheeked Thrush.

Occurs, during migrations, with the foregoing, and is more common in the vicinity of New Haven—judging from the proportionate number of skins in private collections about here. Near Portland, Conn., on the contrary, the true *Swainsoni* type seems to predominate—as shown by specimens in the cabinets of W. W. Coe and John H. Sage.

**5. *Turdus fuscescens* Stephens.** Wilson's Thrush.

A summer resident; breeds. Arrives early in May (May 8). Common in the immediate vicinity of New Haven, especially during the spring migrations.

**6. *Mimus polyglottus* (Linné) Boie.** Mocking-bird.

A rare summer visitant; used to breed here and may occasionally\* do so now. Mr. Geo. Bird Grinnell has taken it near Milford, Conn. Mr. Erwin I. Shores writes me, on the authority of Milton Lester, that it has been killed at Suffield, Conn. Mr. J. N. Clark thinks that it bred pretty regularly at Saybrook, Conn., many years ago; and I am informed by Mr. Osborne that he saw one above the Whitney Lakes, near New Haven, May 30th, 1877. Also taken late in the fall of 1874, by Mr. William Brewster, near Concord, Mass.† “Stratford and New Haven,” Linsley.

There can be little doubt but that Mocking-birds were once common in Connecticut, Rhode Island, and Massachusetts, if not still farther north. In an appendix to the Mass. Agricultural Report for 1863, Samuels gives it as a “rare summer visitant,” stating that it “occasionally breeds;” and in 1864 Allen says that they “have been known to breed in Springfield several times within five years, and in 1860 two pairs nested here. June 20th, 1860, I found a nest containing three freshly laid eggs. . . . Locality, a sandy field growing up to pitch pines, in one of which the nest was placed, about three feet from the ground.”‡

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\* A Catalogue of the Birds of Connecticut, arranged according to their natural families; by Rev. James H. Linsley, published in Am. Jour. of Sci. and Arts, vol. xliv, No. 2, p. 255. April, 1843.

† Rod and Gun, vol. v, No. 24, p. 370, Mar. 13, 1875.

‡ Catalogue of the Birds found at Springfield, Mass., by J. A. Allen. pp. 67–8. 1864.

7. *Mimus Carolinensis* (Linné) Gray. Cat-bird.

An abundant summer resident, arriving early in May (May 4, 1877, Portland; May 5, 1874, Sage; May 6, 1876, C. H. M., and 6, 1877, E. B. Wilson), and remaining till November (Nov. 4, 1874 and 1875); breeds.

8. *Harporhynchus rufus* (Linné) Cabanis. Brown Thrush; "Thrasher."

A common summer resident; breeds. Arrives during the last of April or first of May (April 30, 1876, Osborne; May 1, 1877) departing early in October (Oct. 2).

## Family, SAXICOLIDÆ.

9. *Sialia sialis* (Linné) Haldeman. Common Bluebird.

Resident; abundant during summer; breeds in holes in trees and posts, etc. They arrive early in February (Feb. 8, 1876), remaining till about the middle of November (Nov. 13, 1876). Have found it singing as early as March 5th. Though generally evenly distributed and everywhere a common species, Mr. Shores "could not find it in 1872" about Suffield, Conn.\* A few small flocks frequently winter in secluded spots.

## Family, SYLVIIDÆ.

10. *Regulus calendula* (Linné) Licht. Ruby-crowned Kinglet.

Common during its migrations. Arrives about the middle of April (April 11, 1875, Sage); remaining till the middle of May (16, Osborne). Have taken it in the fall from Oct. 13th to Nov. 24th.

11. *Regulus satrapa* Lichtenstein. Golden-crested Kinglet.

A winter resident; have seen it at repeated intervals from Oct. 13th till spring (May). Commonly found, with the preceding, associated with small flocks of chickadees (*Parus atricapillus*), and frequently accompanied by a few nuthatches of both species (*Sitta Carolinensis* and *S. Canadensis*).

12. *Poliophtila cærulea* (Linné) Sclater. Blue-gray Gnatcatcher.

A rare summer visitant. "Stratford," Linsley. "Two were shot at Wauregan (Windham County), Conn., by Mr. C. M. Carpenter,—a male in 1874 and a female in 1876. Three or four were seen by me

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\* MS. notes of Erwin I. Shores. Esq.

at Providence, R. I., May 23d, 1875.”\* Mr. Jencks writes me that the Connecticut record is a mistake, as all the specimens were taken near Providence, R. I.

Mr. William Brewster thus speaks of their habits and appearance in the south: “When seen one hundred feet or more above the earth they remind one more of insects than of birds, so active, and so very frail and slender do they seem. In motions, they bear, perhaps, a greater resemblance to the Redstart (*Setophaga ruticilla*) than to any other bird, like him launching out frequently after insects and alighting with spread tail and drooping wings. They have withal an impertinent, quizzical air, savoring strongly of Cat-bird ways; the song is indeed quite that of the latter bird, but in miniature (if I may apply such an expression to sound), a quaint mocking little strain, continued half a minute or more at a time, and full of mewings and harsh chatters, with an occasional full round note, but altogether so feeble as scarcely to be audible at twenty yards’ distance. The note used by both sexes is a harsh but rather faint lisp.”†

### Family, PARIDÆ.

#### 13. *Lophophanes bicolor* (Linné) Bonaparte. Tufted Titmouse.

A rare visitor from the south. “New Haven,” Linsley. Josiah G. Ely, Esq., writes me from Lyme, New London Co., Conn., that he shot a Tufted Titmouse, Feb. 27th, 1872, in that vicinity (the ground being covered to a considerable depth with snow), and saw another in Jan., 1874. They were found flitting about among dense hemlocks in a very wild portion of country. It has also been taken near Hartford, Conn., by Dr. D. Crary, but must be regarded as accidental, though a common resident in northern New Jersey (Elizabeth, 1871-72). Also breeds on Long Island “seeking retirement in the lonely part of the woods among the heavy timber.”‡ It has been found as far north as New Hampshire.§

#### 14. *Parus atricapillus* Linné. Black-capped Chickadee.

A common resident; breeds in holes in trees. Gregarious except during the breeding season.

\* Mr. Jencks to H. A. Purdie, see Bulletin of the Nuttall Ornithological Club, vol. ii, pp. 20 and 21. Jan. 1877.

† Annals Lyceum Nat. Hist. N. Y., vol. xi, p. 132, June, 1875.

‡ Birds of Long Island, J. P. Giraud, Jr. p. 78. 1844.

§ Belknap's History of New Hampshire, vol. iii, p. 173. 1792.

15. *Parus Hudsonicus* Forster. Hudsonian Chickadee.

A rare accidental visitor from the north. In the July (1876) number of the Bulletin Nuttall Ornith. Club, I called attention to the first instance of the capture of this northern chickadee in Connecticut: "On Nov. 13, 1875, Mr. Robert Morris, while shooting in a wooded ravine a few miles from town [New Haven], killed a female Hudsonian Titmouse (*Parus Hudsonicus*). The specimen is now in the collection of Mr. Thomas Osborne of this city." Its occurrence so far south must be regarded as purely accidental. Mr. Wm. Brewster took a specimen at Concord, Mass., Oct. 30, 1870.\* This was supposed to be the most southern, and only Massachusetts, record, but as long ago as 1839, Peabody tells us that it "has been found by S. Eliot Greene, Esq., near his house in Brookline."†

## Family, SITTIDÆ.

16. *Sitta Carolinensis* (Gmelin) Latham. White-bellied Nuthatch.

Resident; breeds. Not particularly abundant immediately about New Haven, especially in summer. Its nest, however, has been taken within city limits by the Stadtmüller Brothers.

17. *Sitta Canadensis* Linné. Red-bellied Nuthatch.

A tolerably common winter resident, arriving about the middle of October (Oct. 13, 1875, abundant), and remaining till after the middle of April (April 19, 1876, Osborne).

## Family, CERTHIIDÆ.

18. *Certhia familiaris* Linné. Brown Creeper.

A rather common resident; breeds. Particularly abundant in winter, when it may frequently be seen running about on the elms in the heart of the city.

## Family, TROGLODYTIDÆ.

19. *Troglodytes ædon* Vieillot. House Wren.

A summer resident; breeds. Not abundant. Arrives late in April or early in May (Apr. 27, 1869, Hartford; 27, 1877, Portland; May

\* Am. Nat., vol. vi, No. 5. p. 306. May, 1872.

† A Report on the Ornithology of Massachusetts, by Wm. B. O. Peabody. p. 402. 1839.

2, 1863; 3, 1876; 4, 1861, 1873, all Portland, Conn., Jno. H. Sage), remaining till late in October (Oct. 26 and 30, 1875).

20. *Anorthura troglodytes*, var. *hyemalis* (Vieill.) Coues. Winter Wren.

A winter resident; rather common during migrations. Have seen it early in October (Oct. 2d), and secured a specimen on the 24th of November, 1875. Mr. Grinnell has taken it every month during winter.

21. *Telmatodytes palustris* (Wilson) Baird. Long-billed Marsh Wren.

A common summer resident; breeds abundantly in the brackish water marshes bordering the Quinnipiac river, near New Haven. Mr. A. J. Dayan and myself found dozens of completed nests, a few of which contained from 1 to 5 eggs each, on the 7th of June, 1876. Also breeds in suitable fresh water marshes throughout the State.

22. *Cistothorus stellaris* (Licht.) Cabanis. Short-billed Marsh Wren.

A rather rare summer resident; breeding in suitable localities along our southern border and in the Connecticut Valley. "New Haven," Linsley. Dr. Wood tells me that it is not common about Hartford, Conn.; and Mr. Erwin I. Shores writes me that it breeds in a marsh near Southwick (or Congannick) Ponds, in the town of Suffield, Hartford Co., Conn. (close to the Massachusetts border). Mr. J. G. Ely, of Lyme, Conn., writes me that the Short-billed Marsh Wren breeds abundantly in that vicinity.

NOTE.—The Great Carolina Wren, *Thryothorus ludovicianus* (Latham) Bonap., has been known to breed in Massachusetts\* and on Long Island, and doubtless occurs, as a rare summer resident from the South, in the Connecticut Valley, and along our southern border.

### Family, ALAUDIDÆ.

23. *Eremophila alpestris* (Forst.) Boie. Horned Lark.

A winter resident, occurring along the shore, and also in barren, sandy, tracts, throughout the State. Mr. Dayan, Mr. Osborne, Mr. Grinnell, and myself, have seen it here in fall (Nov. 18, 1874, C. H. M.) and winter, and Mr. W. W. Coe has found it at Portland, Conn., as late as March 26, (1875).

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\* Bull. Nutt. Ornith. Club, vol. i, No. 3, p. 76. Sept. 1876.



## Family, MOTACILLIDÆ.

24. *Anthus Ludovicianus* (Gmelin) Licht. Titlark.

Common along the coast during migrations. Have taken it as late as Nov. 14. It passes north in the month of May (Dr. Wood). Dr. Brewer says that he has "found it, sometimes in large flocks, in open country near the coast, in Massachusetts, in midwinter."\*

## Family, SYLVICOLIDÆ.

25. *Mniotilta varia* (Linné) Vieillot. Black-and-white Creeper.

A summer resident; breeds. Particularly abundant during migrations. Arrives late in April or early in May (April 30, 1877, May 2, 1876), remaining till October (Oct. 2). Mr. J. H. Sage writes that, in company with Mr. J. N. Clark, he took a nest containing five eggs of this species, at Saybrook, Conn., May 30, 1877. I shot it at New Haven on June 23, and have seen several others during the breeding season. Mr. Sage also took another nest containing five eggs ("young well developed"), at Portland, Conn., June 12, 1875.

26. *Parula Americana* (Linné) Bonap. Blue Yellow-backed Warbler.

A summer resident; breeds. One of our commonest migrants. Arrives early in May (May 2d, Osborne). In the fall it is very abundant during the middle and latter part of September, and I have taken it as late as Oct. 13th. Mr. W. W. Coe showed me a number of their beautiful hanging nests, composed entirely of *Usnea*, which he had found about Portland, Conn. It has also been found breeding near New Haven (Maltby Park—Stadt Müller Brothers).

27. *Helmitherus vermivorus* (Gmelin) Bonap. Worm-eating Warbler.

A rare summer resident; breeds. As long ago as the year 1843, Dr. J. D. Whelpley observed this species at New Haven (Linsley), and it has since been taken in this vicinity by several collectors. In the "Bull. Nutt. Ornith. Club," (vol. ii, No. 1, Jan., 1877, p. 21), Mr. H. A. Purdie states that "Mr. Shores shot a male at Suffield (Hartford County), Conn., August 22, 1874. This is, I think, its most northerly record in the Atlantic States yet noted." Also, in the *American Naturalist* for Nov., 1873 (vol. vii, No. 2, p. 692), the same author remarks that Mr. J. N. Clark, of Saybrook, Conn., writes him that he has taken "in the nesting season, *Helmitherus vermivorus*,

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\* Bull. Nutt. Ornith. Club, vol. i, No. 4, p. 92. Nov. 1876.

but as yet has failed to find the nest." Mr. Clark tells me he has seen as many as five individuals in a single day. Mr. Thomas Osborne, of New Haven, has a mounted specimen in his cabinet, procured May 17, 1875. Two or three others specimens were shot near here in May, 1875, and Mr. George Bird Grinnell tells me that he has known of the capture of several in this vicinity.

So little is really known concerning the habits of this rare warbler, that I take great pleasure in quoting the following interesting account of it from the observations of my friend, Mr. William Brewster, of Cambridge, "On the Birds of Ritchie County, West Virginia." Mr. Brewster writes that it is "most partial to the retired thickets in the woods, along water courses, and is seldom or never found in the high open groves. They keep much on the ground, and *walk* about rather slowly, searching for food among the dried leaves. In general appearance they are quite unique, and I rarely failed to identify one with an instant's glance, so very peculiar are all their attitudes and motions. The tail is habitually carried at an elevation considerably above the line of the back, which gives them quite a smart, jaunty, air, and if the dorsal aspect be exposed, in a clear light, the peculiar marking of the crown is quite conspicuous. Seen as they usually are, however, dimly flitting ahead through the gloom and shadow of the thickets, the impression received is that of a dark little bird which vanishes unaccountably before your very eyes, leaving you quite uncertain where to look for it next: indeed, I hardly know a more difficult bird to procure, for the slightest noise sends it darting off through the woods at once. Occasionally you will come upon one winding around the trunk of some tree, exactly in the manner of *Mniotilta varia*, running out along the branches with nimble motion, peering alternately under the bark on either side, and anon returning to the main stem, perhaps the next instant, to hop back to the ground again. On such occasions they rarely ascend to the height of more than eight or ten feet. The males are very quarrelsome, chasing one another through the woods with loud, sharp, chirpings, careering with almost inconceivable velocity up among the tops of the highest oaks, or darting among the thickets with interminable doublings until the pursuer, growing tired of the chase, alights on some low twig or mossy log, and, in token of his victory, utters a warble so feeble that you must be very near to catch it at all, a sound like that produced by striking two pebbles very quickly and gently together, or the song of *Spizella socialis* heard at a distance, and altogether a very indifferent performance."\*

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\* *Annals Lyceum Nat. Hist. N. Y.*, vol. xi, pp. 134-5. June, 1875.

**28. *Helminthophaga pinus* (Linné) Baird.** Blue-winged Yellow Warbler.

A summer resident in southern Connecticut and in the Connecticut Valley; breeds. Not common at New Haven. Mr. L. C. Bragg took a female May 12, and I captured a male on the 24th, 1876. Mr. J. N. Clark finds it breeding regularly, and in considerable numbers, at Saybrook, Conn.\* Mr. W. R. Nichols shot one at Branford, Conn., May 12th, 1877. On the 23d of June last (1877) while collecting with Mr. Wm. H. Taylor, in a piece of woods within a mile of the city of New Haven, I succeeded in shooting a fine adult male of this species, which Prof. Wm. D. Whitney was kind enough to mount for the collection of New England birds now on exhibition in the Peabody Museum of Yale College. The bird kept flitting about so actively in the dense undergrowth that it was with difficulty secured. It unquestionably had a nest in the immediate vicinity.

**29. *Helminthophaga chrysoptera* (Linné) Cabanis.** Blue Golden-winged Warbler.

A rather rare summer resident; breeds in the northern part of the State. Mr. Walter R. Nichols shot one near New Haven August, 24, 1876, and Mr. Osborne tells me that he saw one in May, 1875, killed by a friend of his. I have not yet met with it. The finest specimens of this beautiful warbler that I have ever seen are in the cabinets of Mr. Coe and Mr. Sage, of Portland, Conn. They were taken in that vicinity. Mr. Sage informs me that he has seen it from May 11th, (May 11 and 27, 1876) to the 30th, (May, 30, 1877, Saybrook). Mr. J. N. Clark, of Saybrook, Conn., tells me that he has seen but one specimen there. Mr. Erwin I. Shores writes me from Suffield, Conn.: "Not common; breeds. On July 7th, 1876, I obtained a female and three young just able to fly. Have taken it at two other times." Dr. Crary has taken it near Hartford.

**30. *Helminthophaga ruficapilla* (Wilson) Baird.** Nashville Warbler.

A summer resident; abundant spring and autumn migrant. Arrives early in May. Breeds sparingly throughout the State.

**31. *Helminthophaga peregrina* (Wilson) Cabanis.** Tennessee Warbler.

A rather rare migrant. Two specimens were taken near New Haven during the latter part of May, 1876 (May 24, Osborne; May 26, Bragg). Mr. Erwin I. Shores shot one near Suffield, Conn., June 8,

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\* Am. Nat., vol. vii, No. II, p. 692. Nov. 1873.

1875, which is so late one might almost suspect it of breeding within our limits. Mr. J. N. Clark, of Saybrook, has a specimen in his cabinet in unusually high plumage; it is a rare bird there. I am told by Mr. Clark and others that its note is peculiarly loud and clear, serving to distinguish the species when some distance away.

NOTE.—The Orange-crowned Warbler, *Helminthophaga celata* (Say) Baird, has been taken both in Massachusetts\* and Rhode Island,† and also in New York State (by Mr. E. P. Bicknell, and but a few miles from our western border)‡ and unquestionably occurs within our limits.

**32. *Dendroeca æstiva* (Gmelin) Baird. Yellow Warbler.**

A common summer resident; breeds. Arrives about the first of May (May 7, Osborne; May 4, 1874, and May 5, 1873, Portland, Conn., Sage).

**33. *Dendroeca virens* (Gmelin) Baird. Black-throated Green Warbler.**

A summer resident; very abundant during its migrations. Arrives about May 1st, remaining through the month (May 23); have taken them in the fall, from September 15th to October 18th. Mr. W. W. Coe tells me that they remain through the entire summer in dense swamps about Portland, Conn., and doubtless breed, though he has not yet taken the nest. I am also informed by Mr. J. N. Clark that a few breed at Saybrook, where he has found two nests after the young had hatched. I am surprised at this, for it is the last place in the State where they *ought, theoretically*, to breed.

**34. *Dendroeca cærulescens* (Linné) Baird. Black-throated Blue Warbler.**

A summer resident. Common spring migrant; Mr. Osborne and myself have also taken it here in autumn (October 7, 12, and 19). Arrives about May 10th; breeds sparingly in the northeastern part of the State (Eastford), where two nests were found in June (8 and 13, 1874,) by the Rev. C. M. Jones. §

**35. *Dendroeca cærulea* (Wilson) Baird. Cærulean Warbler.**

A very rare summer visitant from the Southern and Central States. This rare warbler was observed at Stratford, Conn., by Linsley, as

\* Bull. Nutt. Ornithol. Club, vol. i, No. 4, p. 95. Nov. 1876.

† Ibid, vol. ii, No. 1, p. 21. Jan. 1877.

‡ In letter from E. P. Bicknell.

§ Bull. Nutt. Ornith. Club, vol. i, No. 1, p. 11. April, 1876.

long ago as April, 1841. H. A. Purdie says, "a male was obtained by Mr. Shores at Suffield, June 12, 1875."\* Mr. Shores writes me that he "obtained it purely by accident while trying to shoot a Warbling Vireo (*Vireo gilvus*)." So far as I am aware these two are the only instances of its capture within the State.

**36. *Dendroeca coronata* (Linné) Gray. Yellow-rumped Warbler.**

Very common during migrations. Have taken it as early as April 18th (1875). In the fall it may be seen from the last of September till the first of November, some remaining still later (Nov. 15), and Mr. Grinnell informs me that he has taken it every month during the entire winter.

**37. *Dendroeca Blackburniæ* (Gmelin) Baird. Blackburnian Warbler.**

Common during the migrations, being particularly abundant in spring. A few sometimes breed. Arrives about May 9th, remaining till the last of the month (May 27). Also occurs from the middle of September till early in October (Oct. 3). In the spring great numbers of them frequent the elms in the heart of the town. Mr. Josiah G. Ely writes me, from Lyme, Conn., that he "shot a female Blackburnian Warbler in July, 1873, with its belly minus of feathers. It evidently had a nest somewhere in that vicinity."

**38. *Dendroeca striata* (Forster) Baird. Black-poll Warbler.**

One of our most abundant migrants. Arrives from the south about May 13th, remaining till the last of the month (May 30; June 2, 1872, Portland, Conn., Sage). In the autumn they are quite numerous by Sept. 10th, and their number does not decrease much till after the middle of October—some staying till the last of the month (Oct. 26).

**39. *Dendroeca castanea* (Wilson) Baird. Bay-breasted Warbler.**

Sometimes quite abundant during the spring migration (1876, for example); at other times extremely rare, if occurring at all. Arrives about the middle of May, remaining till the last of the month. Mr. Osborne has seen it in fall (Sept. 30 and Oct. 17, 1876). Mr. Shores gives it as "rare," never having taken "but two specimens," at Suffield, Conn.†

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\* Bull. Nutt. Ornith. Club, vol. ii, No. 1, p. 21. January, 1877.

† MS. notes of Erwin I. Shores.

40. *Dendroeca Pennsylvanica* (Linné) Baird. Chestnut-sided Warbler.

A summer resident; breeds. Very abundant during migrations. Arrives early in May (7), the greater number passing north before the first of June.

41. *Dendroeca maculosa* (Gmelin) Baird. Black-and-yellow Warbler.

A common spring and autumn migrant. Arrives about May 12th, remaining till June 1st. Have taken it in the fall, from the middle of September to October 1st, and it probably remains still later.\*

42. *Dendroeca tigrina* (Gmelin) Baird. Cape May Warbler.

A rather rare migrant, though a few are taken every season. Have known of its occurrence from May 10th, (Osborne) to the 25th. Mr. Shores writes me that it is generally rare about Suffield, Conn., but that it was not uncommon there in the spring of 1876.

43. *Dendroeca discolor* (Vieillot) Baird. Prairie Warbler.

A summer resident; not common about New Haven. Breeds sparingly. Mr. Dayan has taken it on May 13th and Sept. 15th. Mr. W. W. Coe tells me that it breeds near Portland, Conn., but is rather rare. I shot one near New Haven, May 14th, 1877. I am informed by Mr. E. I. Shores, of Suffield, that it is not rare about Enfield, Conn. Mr. J. N. Clark tells me that it breeds plentifully about Saybrook, Conn.

44. *Dendroeca dominica* (Linné) Baird. Yellow-throated Warbler.

A rare accidental visitor from the south. Dr. Daniel Crary, of Hartford, Conn., writes me that during fifteen years of bird collecting in that vicinity (in the Connecticut Valley) he has secured several specimens of this rare species. Dr. E. L. R. Thompson also assures me that he has seen it about New Haven. Cones, in his "List of the Birds of New England," states, and very properly too, that "there is no good evidence," that this species "ever straggles as far north as New England,"† but, for some unaccountable reason, in his "Birds of the Northwest" (p. 66) disregards his former correct statement and says that the bird occurs "north to Connecticut (Linsley)." A glance at Linsley's catalogue shows that he did not know of its occurrence in this State.

\* For an interesting account of the habits of this bird, see an article by William Brewster, in Bull. Nutt Ornith. Club, vol. ii, No. 1, pp. 1-7. Jan., 1877.

† Proceed. Essex. Inst., vol. v, p. 270.

45. *Dendroeca palmarum* (Gmelin) Baird. Red poll Warbler.

A common spring and autumn migrant. Arrives, in spring, about the middle of April (13, 1877; 18, 1875), usually remaining but a few days; in fall I have taken it from Oct. 18th to Nov. 4th. But few were seen this spring (1877), and they straggled along in the most unaccountable manner. I shot one as late as May 5th! Along with *D. pinus* and *D. coronata* it may be seen, in spring, long before the hosts of other warblers make their appearance. It is also one of the last to depart in the fall, at which time it is found along fences, and among low bushes, by the road-side, and in open fields. In early spring, before the snow has quite all disappeared, large numbers of them may sometimes be seen, in company with the English Sparrows, running about on the plots of bare ground, and the roots of the elm trees, in the *City Green*, in the heart of New Haven. In fact they seem to pay but little attention to the weather, as may be seen from the circumstance that they were really abundant on the 18th of April, 1875, at a time when the ground was covered with snow nearly a foot deep, with only here and there a bare spot; while none were seen this season (1877) till April 13th, notwithstanding the fact that the ground had been bare since the latter part of March, and the weather unusually mild. Apparently in great haste to reach the breeding grounds, their stay with us, in spring, is generally brief—a few days and all are gone. During the autumnal migrations, however, the case is quite different. Having safely accomplished a long and perilous journey to the far north, and having successfully struggled with the elements and the hungry animate world in rearing and providing for a family of children, its anxiety is over, and now it lingers, for two or three weeks, in its favorite haunts by the road-side, before taking its final departure for Cuba or the Bahamas; or, perchance, it may not pass beyond our own limits, but, finding some suitable spot in the Gulf States, concludes to go no farther, and winters there.

The abundance of this species during its migrations varies considerably in different years. Thus in the spring of 1875 they were very numerous, while this season (1877) less than half a dozen were seen. This remark applies with equal force to *D. pinus* and several other species.

46. *Dendroeca pinus* (Wilson) Baird. Pine-creeping Warbler.

A summer resident; tolerably common during migrations. It breeds in pines, and is more often heard than seen. Arrives before the

middle of April\* (April 14, and probably earlier) and departs in September (Sept. 29, 1875, Sage). They are so partial to the tree whose name they bear that, in speaking of their habits in the "Pine-barrens" of South Carolina and Georgia, I remarked that "it was very appropriately named the *pine-creeeping* warbler, as I never, except on one occasion, saw it alight, even for an instant, on anything but a pine tree; here it would sit by the hour and warble out its sweet song."† I might also state that at such times it is generally so concealed among the branches that one may not unfrequently spend half an hour in vainly endeavoring to "get a shot"—the bird, meanwhile, uttering, at intervals, its characteristic note, which is not unlike a certain strain in the pleasant and perplexing song of the common field-sparrow (*Spizella pusilla*). On referring to my MS. notes on the birds of Central Massachusetts, I find the following: "Seldom found except in pine woods, where a few were found breeding on June 25th, 1874." Here, however, though evidently preferring similar tracts, they may be met with, especially during the migrations, in a variety of situations. In the spring of 1875, for example, they were frequently seen in the City Green hopping about on the ground in company with *D. palmarum* and the English Sparrows, and running up and down on the trunks of the large elms searching for insects. Mr. C. J. Maynard, in his beautiful, but lamentably incomplete, work on the "Birds of Florida," says: "While walking in the piny woods of Florida one will suddenly observe that the trees over his head are filled with birds, where but a moment before not a living thing was to be seen; and his ears will be saluted by a variety of sounds. Beside the loud, harsh notes of the woodpeckers and nuthatches, and the mellow whistle of the bluebirds, the slowly given trill of the pine warblers will occasionally be heard. There are hundreds of these little birds in every passing flock, yet but few of them ever sing. They are extremely active, now searching for insects among the swaying foliage of the pines high overhead, then clinging to the brown trunks to peer into the crevices of the bark, or alighting on the ground. . . . Of all the thousands of this species which spend the colder season in Florida but few remain to breed, and by the middle of March the greater portion leave for the North. They arrive in New England in early April, and by the first of May

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\* Dr. J. A. Allen stated, in the "New England Farmer" for 1861 (p. 540): "The present year [1861] I observed them the 4th of April, at which time a recent snow covered the ground to the depth of several inches."

† Am. Nat., vol. viii, No. 1, p. 7. Jan. 1874.



begin to construct their nests, which are commonly placed in a fork of the topmost limb of a pine tree.”\*

47. *Siurus auricapillus* (Linné) Swainson. Golden-crowned Thrush;  
“Oven Bird.”

A common summer resident, arriving early in May (May 3), and remaining till the latter part of September. Breeds abundantly. Its characteristic loud, but not particularly pleasing, note frequently annoys one while listening for the softer tones of some of the rarer warblers.

48. *Siurus nævius* (Boddaert) Coues.† (*Noveboracensis* of Authors.) Water-Wagtail; Water Thrush.

Rather common during migrations. Possibly a few occasionally remain and breed. Arrives early in May. Have taken it in spring from May 5th to 27th; and in fall from Sept. 28th to Oct. 18th. Mr. Gentry, in his late work on the “Birds of Eastern Pennsylvania,” says that it “cannot be considered either abundant or rare.” The same remark applies here in spring, when they frequent their favorite haunts near some small stream or swampy place in woodland. In the fall, however, they sometimes congregate in rather large flocks and may then be seen on hill-sides away from water.

49. *Siurus motacilla* (Vieillot) Coues. (*Ludovicianus* of Authors.) Large-billed Water Thrush.

Not rare in southern Connecticut, where it breeds regularly, and probably in considerable numbers. Arrives earlier than either of the other species. I shot a fine male on the 27th of April, 1877. That they also breed very early is shown by the fact that a female, containing an egg ready for the nest, was shot by my friend, Mr. Dayan, on the 17th of May, 1876; and Mr. J. N. Clark, of Saybrook, Conn., tells me that the young are generally hatched *before* May 25th. The fact of its breeding regularly in southern New England has now become so well established that it would be superfluous to cite the numerous published records of its capture.

In habits it seems to agree with *S. nævius*—at least in its fondness for shaded streams. Its note is peculiarly loud and clear, and does

\* The Birds of Florida. By C. J. Maynard. Part II, p. 49. Salem, 1873.

† For the nomenclature of this genus, see Coues, in Bulletin of the Nuttall Ornith. Club, vol. ii, No. 2. April, 1877.

not resemble that of any other bird I have ever heard. Dr. F. W. Hall shot a pair in Maltby Park (near New Haven) June 10th, 1874; they had evidently bred there. W. R. Nichols and Thos. B. Osborne saw several specimens on the 2d of May, one of which they secured; and on the 15th I saw still another. I am informed by Mr. J. N. Clark, of Saybrook, that a favorite site for their nests is among the upturned roots of a fallen tree.

In writing of the habits of this species in West Virginia, Mr. Brewster says: "While the northern Water Thrush [*S. naevius*] was confined to the muddy banks of the creek—and I will remark *en passant* that I never saw one other than in a muddy locality—this species seemed to delight in the pebbly streams of the hills; just such streams as in the New England mountains would be called good trout brooks, overshadowed by mighty forest trees, frequently choked up by fallen logs, and abounding in beautiful cascades, still, deep pools, and wild rocky ravines. In the deepest, darkest retreats you were most likely to find him, and here, on several occasions, I was fortunate enough to hear his song. It is somewhat like that of *S. noveboracensis* [*S. naevius*], being quite as loud, almost as rapid, and commencing in nearly the same way, but lacking the beautiful crescendo termination, and, altogether, a less fine performance. Represented by words, it would be nearly as follows: *pseur, pseur, per sèe ser*. This is usually uttered several times in succession from some shelving rock, or fallen log overhanging the stream; the bird in the intervals between each repetition tilting its body incessantly, and looking nervously about as if he didn't half like your appearance and had a good mind to be off, and this expression, in the majority of cases, soon finds vent in action, for he is a very shy little fellow the moment he begins to suspect that he is wanted to grace your cabinet. Come upon him suddenly, however, as he is running nimbly along the margin of some quiet pool or rippling eddy, and at times he will seem to pay little regard to your presence, and you may have a fine chance to observe his motions and sandpiper-like ways, as he wades knee deep into the water, or splashes through it in hot pursuit of some aquatic insects."\*

## 50. *Oporornis agilis* (Wilson) Baird. Connecticut Warbler.

A rare spring and autumn migrant. The only specimen that I have ever seen alive was a female, which I shot near New Haven, Oct. 2d,

\* Annals Lyceum Nat. Hist. N. Y., vol. xi, pp. 136-37. June, 1875.

1875. Nearly four years ago Mr. H. A. Purdie called attention to the fact that it had been obtained, in September, at Saybrook, Conn., by Mr. J. N. Clark;\* and Mr. Clark has recently informed me that he has taken several specimens there in fall, and one "full-plumaged male in spring." This last is the finest specimen I have ever seen, and, at first sight, I mistook it for the Mourning Warbler (*Geothlypis Philadelphia*), the male of which it closely resembles, both in the deep ash of the throat and breast (which is almost black where it joins the yellow below), and in the shade and limited extent of the yellow of the belly. The ring around the eye, however, is well marked, and pure white.

As its name indicates, this species was first discovered in Connecticut, and by the distinguished Ornithologist, Alexander Wilson. He met with it but once in this State, but afterwards found it in Pennsylvania, and says, "It was found, in every case, among low thickets, but seemed more than commonly active, not remaining for a moment in the same position."† Its habits are such as to render it unlikely to be observed unless present in considerable numbers.

### 51. *Oporornis formosus* (Wilson) Baird. Kentucky Warbler.

A rare summer visitor from the South. Mr. Erwin I. Shores, who has favored me with so many valuable notes concerning our rarer birds, writes that he "obtained a male of this species at Suffield, Conn., Aug. 16th, 1876,"‡ thus adding another bird, not only to the Avi-fauna of Connecticut, but also to New England. I am aware that Dr. Coues, in his "Birds of the Northwest" (p. 73), states that the species occurs "north to the Connecticut Valley," but on what authority I am unable to surmise. Perhaps the learned Doctor's knowledge of the distribution of birds, and of that something in their hearts which oftentimes causes those inexplicable peregrinations, together with his marvelous power of intuition, told him that it did occur in the Connecticut Valley, and had long been waiting to be discovered by Mr. Shores. Indeed, nearly ten years ago, Dr. Coues prophesied that "the occurrence of this species as a rare or casual summer visitor in southern New England is to be confidently anticipated,"§ and it is an old saying that probabilities become facts if only given time enough.

\* Am. Nat., vol. vii, No. 2, p. 693, Nov. 1873.

† American Ornithology. Vol. ii, p. 160. Edinburgh. 1831.

‡ MS. notes of Erwin I. Shores.

§ Proceed. Essex Inst., vol. v, p. 269. 1868.

Its nest was found at Sing Sing, Westchester Co., N. Y., in June, 1875, by Mr. A. K. Fisher,\* and Mr. E. P. Bicknell writes me that he secured a male at Riverdale, in the same county, May 30, 1876. Giraud found it on Long Island many years ago.† Wilson says, "This species is seldom seen among the high branches, but loves to frequent low bushes and cane swamps, and is an active, sprightly bird. Its notes are loud, and in threes, resembling *tweedle, tweedle, tweedle*. . . . It appeared to me to be a restless, fighting species, almost always engaged in pursuing some of its fellows; though this might have been occasioned by its numbers, and the particular season of spring, when love and jealousy rage with violence in the breasts of the feathered tenants of the grove; who experience all the ardency of those passions no less than their lord and sovereign man."‡

Since writing the above I learn from Mr. J. G. Ely of Lyme, Conn., that he has "shot one Kentucky Warbler."

**52. *Geothlypis trichas* (Linné) Cabanis. Maryland Yellow-throat.**

A common summer resident, breeding plentifully. Arrives early in May (May 5), remaining till late in the fall (Nov. 1st, 1876).

**53. *Geothlypis Philadelphia* (Wilson) Baird. Mourning Warbler.**

A rather rare migrant, but probably more abundant than commonly supposed—not coming till after most of the warblers are gone. Have only seen it in spring. Mr. Bragg shot a male on May 24th, 1876, in low bushes. On the following day Mr. Dayan secured two males; and I saw several on the morning of the 27th. Mr. Thomas Osborne has seen it as early as May 15th (May 15 and 17, 1876). I shot a beautiful male near Savin Rock, Conn., May 25th, 1877. Mr. Grinnell tells me that he killed a pair (♂ and ♀) late in May, 1875, near Milford, Conn. Mr. J. N. Clark, also, has killed it, late in May, at Saybrook, Conn. At Easthampton, Mass., in the spring of 1874, I shot two specimens: "The first, May 27th, in a brush-heap; and the other, May 28th, on a large birch tree." Large numbers of them breed regularly, in suitable localities, in Lewis and Herkimer Counties, in northern New York. It also breeds abundantly about Umbagog Lake, Oxford Co., Maine (Brewster), and in Minnesota (T. Martin Trippe), even as far west as "the Red River, between Dakota and Minnesota" (Coues).

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\* Am. Nat., vol. ix, No. 10, p. 573. Oct., 1875.

† Birds of Long Island. By J. P. Giraud, Jr., p. 50. 1844.

‡ Wilson's American Ornithology. Vol. ii, p. 151-2. 1831.

Regarding its song, Samuels, in his "Birds of New England," says, "Its note was a simple chirp, with a warbling termination like the syllables *chirpchree*, *chirpchree*, uttered in a soft, pensive tone" (p. 207). I am perfectly familiar with the song of the bird in question, but never heard it utter a note that could, by any legitimate stretch of the imagination, be construed into Samuels' "*chirpchree*." Its common song consists of a simple, clear, warbling whistle, resembling the syllables 'trúē, 'trúē, 'trúē, 'trú, 'toó, the voice rising on the first three syllables and falling on the last two. Sometimes, when otherwise occupied, the first, or first two, syllables are omitted. All through the breeding season, and till late in July, they have a very characteristic habit of perching, at frequent intervals during the day, on some branch, generally a dead one, and commonly ten or fifteen feet from the ground, and singing for half an hour at a time.

**54. *Icteria virens* (Linné) Baird.      Yellow-breasted Chat.**

A common summer resident, breeding in dense undergrowth. Arrives before the middle of May (May 13, 1876, Osborne; 14, 1877). Extends up the Connecticut Valley to Massachusetts ("not rare" at Suffield).<sup>\*</sup> Given by Emmons, in 1833, as an "occasional visitant" in Massachusetts.<sup>†</sup> Their loud, ringing, notes surpass those of the Catbird and almost equal the richly varied song of the Brown Thrush (*Harporhynchus rufus*). Its habits so closely resemble those of its western congener (var. *longicauda*) that I take the liberty to quote the following brief extract, relating to some of the peculiarities of that bird, from my report on the Mammals and Birds collected by the U. S. Geol. Survey of the Territories in the year 1872: "They are shy, suspicious creatures, and, although when disturbed they flit about in a scolding, angry manner, generally manage to keep out of sight. You hear them in the bushes imitating the mewing of a cat, the shrill notes of the Jay, sometimes singing like a Catbird, and again they sing sweetly in their own peculiar manner. They have a strange habit of elevating themselves in the air to the height of thirty or forty feet, then, poising for a moment, descend again to the bushes. During the descent they jerk themselves about in the air, at the same time uttering clear, ejaculated notes, which can be heard for quite a distance, and are not altogether unpleasant to the ear."<sup>‡</sup>

<sup>\*</sup> MS. notes of Erwin I. Shores, Esq.

<sup>†</sup> See Hitchcock's Report, p. 547. 1833.

<sup>‡</sup> See Hayden's Report for 1872, p. 675.

Wm. Brewster, Esq., speaking of its habits in West Virginia, remarks that they arrived there about May 1st, "and for a few days were silent, but soon became very noisy, especially when their retreats were invaded. Their notes are so varied as almost to defy description. What I took to be the *song* of the male was a series of about eight very loud bell-like whistles, commencing quickly, and becoming slower and more emphatic toward the end, then, after an interval of a few seconds, would follow a scolding chatter, to be immediately succeeded by a single very clear note, then the series of whistles again, but all these notes were varied to an almost infinite extent. All this time the bird would be dodging through the bushes ahead, keeping always in the thickest places, and perhaps, after a moment of silence, would suddenly strike up directly behind you. In this way I have frequently pursued one for fifteen or twenty minutes without so much as getting a glimpse at him. Several times, however, when I came upon him suddenly, he would put on a very innocent and injured air and vociferate his notes directly *at* me, as if to dispel any possible suspicion, on my part, that he had been running, or, to speak more literally, flying away."\*

**55. *Myiodiocetes mitratus* (Gmelin) Audubon      Hooded Warbler.**

A summer resident, breeding in the Connecticut valley and along our southern border. Although breeding abundantly at Saybrook, Conn., according to Mr. J. N. Clark (recorded by H. A. Purdie),† I have, as yet, seen but a single specimen from this vicinity. An adult female was shot at Hamden (near New Haven) June 2, 1874, by Dr. F. W. Hall. It was evidently breeding. Still it was found here in June, by Dr. Whelpley, as long ago as 1842.‡ Mr. Clark writes me from Saybrook: "The Hooded Warbler is very abundant here in dense woods, breeding everywhere in suitable places, always in a low Laurel (*Kalmia*) bush." Mr. E. I. Shores has taken it at Suffield, Conn., near the Massachusetts border, but in the Connecticut Valley.

My friends, Messrs. John H. Sage of Portland, Conn., and Eugene P. Bicknell of Riverdale, Westchester Co., N. Y., have recently called my attention to an interesting state of plumage, in the female of this species, which was alluded to by Wilson§ and Nuttall,|| but

\* Ann. Lyc. Nat. Hist. N. Y., vol. xi, pp. 137-8. June, 1875.

† Am. Nat., vol. vii, No. 11, p. 692. Nov., 1873.

‡ Linsley's Catalogue of the Birds of Connecticut, p. 257. 1843.

§ American Ornithology, vol. ii, p. 136. 1831.

|| Manual of Ornithology. Vol. i, p. 374. 1832.

has since been denied by both Coues\* and Baird,† who positively, assert that the female has no black on the head. Concerning it, Mr. Sage favors me with the following note: "When collecting at Saybrook, Conn., with Mr. J. N. Clark, May 30th, 1877, he shot a female *M. mitratus* in a plumage not mentioned in our Ornithological works, and thinking a description would be interesting, I send the following: Bill black. Feet flesh-color. Head and fore part of breast black (but not so pure as in the adult male), with slight indications of black on the throat. A broad patch on the forehead, extending down on the cheeks, with the under parts bright yellow. Ear-coverts tinged with olive. Upper parts olive-green. Wings unmarked. Greater part of inner webs of outer three tail feathers white. The ova of this specimen were large. We took the nest with four eggs."

I have lately seen, in the cabinet of Mr. Sage, the bird from which the above description was taken, and have now before me another female (killed by Dr. F. W. Hall, near New Haven, June 2, 1874) which agrees well with the description of Mr. Sage's specimen, but has the crown of the head, or "hood," deep black—as rich as in the male. The lores also, in this specimen, are black, and the auriculars lack the olive tinge, being bright yellow. Since the birds from which Prof. Baird and Mr. Ridgway, and Dr. Coues, took their descriptions were dried skins, and not "in the flesh," it is not so surprising that the mature females were mistaken for young males. From the limited amount of material I have been able to examine, and from the notes given me by Mr. Sage and Mr. Bicknell, I am inclined to believe that the female bird, like the male, is several years—at least three—in attaining its full plumage; and that the two sexes, when fully adult, can only be distinguished by the fact that, in the female, the throat, though strongly tinged with black, is never *pure black* as in the male.

**56. *Myiodiocetes pusillus* (Wilson) Bonaparte.** Green Black-capped Fly-catching Warbler.

A tolerably common spring migrant, arriving about the middle of May. Have not taken it later than the 25th. This species is by no means so common here as it seems to have been formerly.

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‡ Coues' Key to N. Am. Birds. p. 109. 1872.

§ Baird, Brewer and Ridgway, History N. Am. Birds, vol. i, p. 314. 1874.

57. *Myiodioides Canadensis* (Linné) Audubon. Canadian Fly-catching Warbler.

Common during the migrations. Arrives early in May. Have taken it from the 6th to the 29th. Mr. W. W. Coe informs me that it doubtless breeds about Portland, Conn., as he has seen it there throughout the summer.

58. *Setophaga ruticilla* (Linné) Swainson. Redstart.

A common summer resident; breeds. Arrives early in May. Have taken it from May 8th to September 22d. Mr. Stadtmüller has a very beautiful nest of this species which "was placed in the fork of an oak tree about fifteen feet from the ground. It was built of grass and bits of paper, and covered with cotton all over outside, and lined with a few horse hairs."\* It contained four eggs, June 10, 1874.

Family, TANAGRIDÆ.

59. *Pyranga rubra* (Linné) Vieillot. Scarlet Tanager.

A summer resident; not uncommon. Most frequent during the spring migrations; breeds. Arrives about May 10th, after which date they are common till the first of June. Took a female Sept. 11th, 1875.

60. *Pyranga æstiva* (Linné) Vieillot. Summer Redbird.

A rare summer visitant from the South. "Stratford and New Haven, Linsley," and in a foot-note he further states that "The Summer Redbird is more rare than the Scarlet Tanager, though I have taken both here [Stratford] during the season of cherry blossoms."† In the Bulletin of the Nuttall Ornithological Club for Jan., 1877 (vol. ii, No. 1, p. 21), Mr. Purdie says, "Mr. Jencks informs me that a male was shot, a few years since, on Ten-mile River, six or eight miles northeast of Providence," R. I. I have never met with it except in Florida, where it has a very pleasant song. Dr. Thompson, of this city, informs me that he shot one near New Haven, in summer, about five years ago; and I am told by Prof. Wm. D. Whitney that a friend of his, who was perfectly familiar with the species, saw two individuals, at different seasons, in Hillhouse Avenue, New Haven.

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\* MS. notes of the Stadtmüller Brothers.

† Am. Jour. Sci. and Arts, vol. xlv, No. 2, p. 261. April, 1843.



Mr. Erwin I. Shores writes me that he killed one at Suffield, Conn. (in the Connecticut Valley) July 21st, 1876. Does it not sometimes breed here?

### Family, HIRUNDINIDÆ.

#### 61. *Hirundo horreorum* (Barton.) Barn Swallow.

A common summer resident, breeding abundantly under the roofs of barns. Arrives during the latter part of April (April 21, 1877), remaining till September. Under the head of this species, Peter Kalm wrote, from Raccoon, New Jersey, in 1750: "I observed them for the first time on the 10th of April [new style]; the next day in the morning, I saw great numbers of them sitting on posts and planks, and they were as wet as if they had been just come out of the sea," and the translator of his "Travels," John Reinhold Forster, F.A.S., puts in a foot-note, saying: "It has been a subject of contest among naturalists, to determine the winter-retreat of *Swallows*. . . . The question must therefore be decided by facts; nor are they wanting here: *Dr. Wallerius*, the celebrated *Swedish* Chemist, wrote in 1748, *September* the 6th, O. S., to the late Mr. *Klein*, Secretary of the City of *Dantzick*: 'That he has seen more than once *Swallows* assembling on a reed, till they were all immersed and went to the bottom; this being preceded by a dirge of a quarter of an hour's length. He attests likewise, that he had seen a *Swallow* caught during winter out of a lake with a net, drawn, as is common in northern countries, under the ice: this bird was brought into a warm room, revived, fluttered about, and soon after died. Mr. *Klein* applied to many *Fermiers generaux* of the King of *Prussia's* domains, who had great lakes in their districts. . . . All the people questioned made affidavits upon oath before the magistrates."

"*First*, The mother of the Countess *Lehndorf* said, that she had seen a bundle of Swallows brought from the *Frith-Haff*" (a lake communicating with the *Baltic* at *Pillau*) which when brought into a moderately warm room, revived and fluttered about. *Secondly*, Count *Schlieben* gave an instrument on stamped paper, importing, that by fishing on the lake belonging to his estate of *Gerdauen* in winter, he saw several *Swallows* caught in the net, one of which he took up with his hand, brought it into a warm room, where it lay about an hour, when it began to stir, and half an hour after it flew about in the room. *Thirdly*, *Fermier general* (*Amtman*) *Witkowski* made affidavit, that in the year 1740, three *Swallows* were brought

up with the net in the great pond at *Didlacken*; in the year 1741, he got two *Swallows* from another part of the pond, and took them home, (they all being caught in his presence); after an hour's space they revived all in a warm room, fluttered about, and died three hours after. 4thly, *Anitman Bünke* says, that having had the estate *Kleskow* in farm, he had seen nine *Swallows* brought up in the net from under the ice, all which he took into a warm room, where he distinctly observed how they gradually revived; but a few hours after they all died. Another time his people got likewise some *Swallows* in a net, but he ordered them again to be thrown into the water. 5thly, *Andrew Rutta*, a master fisherman, at *Oletsako*, made affidavit, 1747, that 22 years ago, two *Swallows* were taken up, by him, in a net, under the ice, and being brought into a warm room, they flew about. 6thly, *Jacob Kosiulo*, a master fisherman, at *Stradauen*, made affidavit, that in 1736, he brought up in winter, in a net, from under the ice of the lake at *Raski*, a seemingly dead *Swallow*, which revived in half an hour's time, in a warm room, and he saw, a quarter of an hour after, the bird grow weaker, and soon after dying. 7thly, I can reckon myself among the eye-witnesses of this *paradoxon* of natural history. In the year 1735, being a little boy, I saw several *Swallows* brought in winter by fishermen, from the river *Vistula*, to my father's house, where two of them were brought into a warm room, revived, and flew about. I saw them several times settling on the warm stove (which the *Northern* nations have in their rooms) and I recollect well that the same forenoon they died, and I had them, when dead, in my hand. . . . . In *January* [1754] the lake of *Lybshau*, belonging to these estates, being covered with ice, I ordered the fishermen to fish therein, and in my presence several *Swallows* were taken; which the fishermen threw in again; but one I took up myself, brought it home, which was five miles from thence, and it revived, but died about an hour after its reviving. These are facts, attested by people of the highest quality. . . . . It is therefore highly probable, or rather incontestibly true, that *Swallows* retire in the *Northern* countries during winter, into the water, and stay there in a torpid state, till the return of warmth revives them again in spring.”\*

Not many years ago I brought upon myself the everlasting odium of an old lady, in the northern part of New York State, by presuming to question her statement that she had seen, “with

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\* *Peter Kalm's Travels into North America*, vol ii, pp. 140-44. 1771.

her own eyes," a number of Swallows that had been exhumed, in a torpid state, from the muddy bottom of a pond in the neighborhood of her dwelling. She further stated that, on taking them into the kitchen, "they soon came to life and flew about the room," but whether this premature "thawing out" was followed, like the cases above recorded by Forster, by an equally speedy death, I do not remember.

62. *Tachycineta bicolor* (Vieillot) Cabanis. White-bellied Swallow.

A common summer resident, breeding in holes in trees (generally standing in or about ponds). The earliest to arrive and last to depart. Mr. Grinnell has observed it as early as April 7th, and I have found it quite common by the 13th.

In looking over Mr. W. W. Coe's note book I find the following interesting item: "While collecting in the vicinity of Portland, Conn., June 14th, 1873, I found, in the same tree, three Bluebird's eggs and four White-bellied Swallow's eggs, and thereby hangs a tale: in cutting away the hole to take out the Bluebird's eggs, I noticed a white feather sticking up through the nest. Never having seen feathers in a Bluebird's nest, and knowing that the White-bellied Swallows build theirs almost entirely of them, I thought the Bluebirds might have driven off the Swallows and appropriated the nest to their own use. On removing the Bluebird's nest I found this to be the case, for, underneath it was the nest of the White-bellied Swallow complete and containing four fresh eggs—the eggs of both are now in my cabinet."\*

63. *Petrochelidon lunifrons* (Say) Solater. Cliff Swallow; Cave Swallow.

A common summer resident, breeding abundantly under the caves of barns. Arrives about April 20th (April 15, 1877, Osborne; 21, 1877, A. J. Dayan), remaining till September. Professor Verrill, some years since, showed conclusively that the Cliff Swallow had not, as formerly supposed, immigrated from the West, but was actually known in New England as long ago as the year 1800—long before its discovery in the West. He also states that a large colony of them was known to breed at Windsor, Conn., in 1830.†

\* MS. notes of W. W. Coe.

† *Proceed. Bost. Soc. Nat. Hist.*, vol. ix, p. 276, July 1, 1863.

64. *Cotyle riparia* (Linné) Boie. Bank Swallow.

A common summer resident, breeding in colonies in holes in banks, generally near some pond or river. Arrives early in May (April 21, 1877, A. J. Dayan). Williams, writing of the Swallows of Vermont, in 1794, relates the following, which I transcribe for what it is worth: "The usual times of the appearance and disappearance of these birds, serve to mark the temperature of the climate, with as much precision, as any of the phenomena of nature. But they do not seem to be properly birds of passage. At *Danby* in this State, the inhabitants report, that some of them were taken out of a pond in that town, some years ago. A man was employed in the winter, to procure the roots of the pond lily, for medicinal purposes. Among the mud and roots which he threw out, several swallows were found enclosed in the mud; alive, but in a torpid state. . . . It has been doubted by some able naturalists, whether it is possible for the Swallow to live in such a situation. I saw an instance which puts the possibility of the fact beyond all room for doubt. About the year 1760, two men were digging in the salt marsh, at Cambridge, in Massachusetts: on the bank of the Charles River, about two feet below the surface of the ground, they dug up a Swallow, wholly surrounded and covered with mud. The Swallow was in a torpid state, but being held in their hands, it revived in about half an hour. The place where this Swallow was dug up was every day covered with the salt water, which at every high tide, was four or five feet deep. The time when this Swallow was found was the latter part of the month of February."\*

65. *Stelgidopteryx serripennis* (Audubon) Baird. Rough-winged Swallow.

A rare summer visitant. "A female of this species was shot at Suffield, Conn., by Mr. Shores, June 6th, 1874."† My friend, Mr. Eugene P. Bicknell, informs me that he has found it in numbers at Riverdale, N. Y., within a few miles of the Connecticut line, and that it breeds there—sometimes placing its nest "under a bridge."

66. *Progne purpurea* (Linné) Boie. Purple Martin.

A summer resident, breeding in "Martin Boxes" in villages. Arrives during the middle or latter part of April (April 17, 20, 25,

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\* The Natural and Civil History of Vermont. By Samuel Williams. pp. 115-16. Printed at Walpole, N. H. 1794.

† Purdie in "Nuttall Ornith. Bulletin, vol. ii, No. 1, p. 21. Jan. 1877.

1877). A large colony of them is located over the First National Bank, in the center of New Haven. They are abundant at Guilford, Conn., and a single pair breeds on Faulkner's Island, occupying a house erected for them by Capt. Brooks.

### Family, AMPELIDÆ.

#### 67. *Ampelis garrulus* Linné. Bohemian Waxwing

A rare, almost accidental, winter visitant. On the 11th of February, 1875, Prof. S. I. Smith saw a large *Ampelis* which he thinks was, without doubt, *A. garrulus*. It was in the old wooded cemetery in New Haven. Prof. Smith is familiar with the bird in question, having seen it in Maine. A number of cases of its occurrence in Massachusetts have been recorded, but the only instance of its capture in this State is that given by J. A. Allen. "It has been taken in Connecticut [near Hartford] by Dr. Wood,"\* and the Doctor tells me that he shot them by accident, when firing into a flock of Cedar Birds. "Several were shot on Long Island in 1830 and 1832."†

#### 68. *Ampelis cedrorum* (Linné) Scator. Cedar Bird; Cherry Bird.

A resident. Generally common. Breeds in orchards and low thickets. Gregarious. Almost the only bird that feeds, to any great extent, on canker worms.

### Family, VIREONIDÆ.

#### 69. *Vireo olivaceus* (Linné) Vieillot. Red-eyed Vireo.

An abundant summer resident, breeding chiefly in high woodland. Arrives during the first week in May (May 6), remaining as late as the first of October (Oct. 2). Superfluously noisy.

#### 70. *Vireo gilvus* (Vieillot) Bonaparte. Warbling Vireo.

A common summer resident, breeding in orchards. Arrives before the middle of May (May 7, 1876, Osborne; 12, 13, 14, 1877.) Coues thus briefly alludes to the habits of this pleasing little songster: "Not born to 'waste its sweetness on the desert air,' the Warbling Vireo forsakes the depths of the woodland for the park and orchard and

\* Notes on some of the Rarer Birds of Massachusetts, p. 25 1869.

† Giraud's Birds of Long Island, p. 165. 1844.

shady street, where it glides through the foliage of the tallest trees, the unseen messenger of rest and peace to the busy, dusty haunts of men."

71. *Vireo flavifrons* Vieillot. Yellow-throated Vireo.

A tolerably common summer resident; particularly abundant in spring and fall. Arrives early in May (May 6), remaining till after the middle of September (Sept. 15, 17, 1875).

72. *Vireo solitarius* (Wilson) Vieillot. Blue-headed, or Solitary Vireo.

Not uncommon during the migrations. A few breed. Arrives during the first week in May (May 2, 1876, Osborne; 6, 1875, C. H. M.; May 5, 1877, Nichols). Have taken it as late as Oct. 13th. A nest of this species, found June 18th, 1875, near New Haven (Beaver Swamp), by the Stadtmüllers, "was out on the limb of a Chestnut tree about 30 feet from the ground, and was constructed of the bark of different kinds of trees, lined with grass. Moss and caterpillars' silk were plastered outside. It contained four eggs, which were two-thirds hatched."\*

73. *Vireo noveboracensis* (Gmelin) Bonaparte. White-eyed Vireo.

A summer resident, but not particularly common except along southern Connecticut, and in the Connecticut Valley, where it is common all the way up to the Massachusetts line (Suffield, E. I. Shores). Arrives before May 10th (May 7, Osborne).

NOTE.—*Vireo philadelphicus* Cassin, undoubtedly occurs within our limits, as a rare, or accidental, visitant, but as yet no record of its capture has appeared. On Sept. 7th, 1875, Mr. William Brewster "shot a female of this beautiful little species in Cambridge, Mass."†

### Family, LANIIDÆ.

74. *Collurio borealis* (Vieillot) Baird. Butcher Bird; Shrike.

A somewhat irregular winter resident. Arrives in October or November (Oct. 29, 1876, Sage;) remaining till the latter part of March (March 24, 1876, Osborne). Very abundant some years, and equally scarce in others. Mr. Maynard says, "when the Lesser Red-

\* MS. notes of the Stadtmüller Brothers.

† Bull. Nutt. Ornith. Club, vol. i, No. 1, p. 19. April, 1876.

polls or the Pine Finches are common, the Shrikes follow them and prey upon them." During the winters of 1874-5 and 1875-6, when the Red-polls (*Ægiothus linaria*) and the Pine Finches (*Chrysomitris pinus*) were here, Butcher Birds were notably scarce; while during the past winter (1876-7) Shrikes have been uncommonly plenty, but neither of the other birds were seen at all. It is but fair to state, however, that during the first two winters mentioned neither the Linnets nor Finches were here in large enough numbers to have afforded the Butcher Birds a reliable source of diet. Last winter the English Sparrows supplied all deficiencies and it was no uncommon thing to see a Butcher Bird flying across the street with one in its talons. The "poor sparrows," unused to danger of any sort, were utterly helpless, and at one time it seemed as if we were actually going to be rid of the little pests, but warm weather came to their relief, driving the intruders back to their boreal homes, and now the sparrows are apparently as numerous as ever they were. Mr. Nichols shot one Jan. 13th, 1876, whose stomach contained grasshoppers! Where could it have found them at that season?

**75. *Collurio Ludovicianus* (Linné) Baird.      Loggerhead Shrike.**

A rare visitor from the South and West. Mr. W. W. Coe has a fine specimen of this species in his cabinet, which he shot near Portland, Conn., in Nov., 1876. Franklin Benner, Esq., writes me that he "saw a Shrike of some species at Mt. Carmel [near New Haven] May 24th, 1873," which, if he was not mistaken in the bird, could hardly have been the northern Butcher Bird, and might have been this species.

**Family, FRINGILLIDÆ.**

**76. *Pinicola enucleator* (Linné) Cabanis.      Pine Grosbeak.**

An irregular winter visitant. They were here through the months of Feb. and Dec., 1875, and during Jan. and Feb., 1876, but none were seen last winter. Messrs. Coe and Sage, of Portland, Conn., tell me that it is found there regularly *every winter*, though the red males are not always seen, and that they have observed it as late as March 12th (1873), and as early as Nov. 24th (1875, and 25, 1874).

**77. *Carpodacus purpureus* (Gmelin) Gray.      Purple Finch.**

Resident, breeding abundantly. Gregarious. Mr. Grinnell informs me that he has taken it during every month of the year. Dr.

Wood, of East Windsor Hill, tells me that they were almost unknown here twenty years ago, and have gradually become common since. I am likewise informed by Mr. Clark, of Saybrook, that the bird has only recently become a common species in that vicinity.

78. *Loxia leucoptera* Gmelin. White-winged Crossbill.

An irregular winter visitant. They were not uncommon during the months of Jan., Feb. and March, 1875.

79. *Loxia curvirostra*, var. *Americana* (Wilson) Coues. Red Crossbill.

An irregular winter visitant, like the last, and more frequently seen. Linsley gave it in his list, stating that it had "been repeatedly seen in Trumbull, in this [Fairfield] county, by a Mr. Beers." Mr. W. W. Coe has taken a number of this, as well as the preceding species, about Portland, Conn. A few were seen about New Haven early in Dec., 1876. It has been known to breed near New York City.\*

80. *Ægiothus linaria* (Linné) Cabanis. Red-poll Linnet.

Also an irregular winter visitant. They were quite common here during the month of March, 1875 (and Mr. Sage saw a flock at Portland, Conn., March 31), but none were seen in the winters of 1875-6 and 1876-7. Mr. W. W. Coe took it at Portland, Conn., March 22d, 1878, and saw there large flocks of them (including many highly plumaged males) in March, 1875.†

81. *Chrysomitris pinus* (Wilson) Bonaparte. Pine Finch; Pine Linnet.

An irregular fall and winter visitant. Quite common from Oct., 1874, till March, 1875. Also seen in Oct., 1875. Linsley says: "I took one specimen from a large flock, which was here in my yard [Stratford, Conn.] as late as Nov. 7th, 1840." In March and April, 1873, I found them extremely abundant near the boundary line between Georgia and South Carolina, notwithstanding the statement, in Baird, Brewer, and Ridgway's great work, that: "according to Dr. Coues, this species occasionally strays as far to the South as the Carolinas, but it is not common there," (p. 481). This case simply affords another example of their irregular migrations.

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\* Am. Nat., vol. x, No. 4, p. 237. April, 1876.

† MS. notes of W. W. Coe, Esq.



82. *Chrysomitris tristis* (Linné) Bonaparte. Common Yellowbird.

An abundant resident, breeding late. Common everywhere, and is gregarious.

83. *Plectrophanes nivalis* (Linné) Meyer. Snow Bunting.

A common winter visitor, generally seen during snow-storms. Linsley, in his "Catalogue of the Birds of Connecticut," so frequently cited, says, "Large flocks of the Snow Bunting were repeatedly seen here in the winters of 1840, 1841 and 1842. Previous to that period, *I had not seen one here in eighteen years.*" (p. 261, foot-note).

84. *Plectrophanes Lapponicus* (Linné) Selley. Lapland Longspur.

Occurs as a winter visitant, along with *P. nivalis*, though no record of its capture has yet been published. My friend, Mr. Geo. B. Grinnell informs me that he has seen half a dozen specimens, killed near the Connecticut River (Portland, Conn.), by Mr. W. W. Coe. Mr. Walter P. Nichols has taken it near New Haven, and Mr. Erwin I. Shores "obtained a male out of a flock of *P. nivalis*, in Nov., 1874" at Suffield, Conn. Mr. Coe has taken it as late as March 16th, (1875).

85. *Passerculus princeps* Maynard. Maynard's Sparrow.

Probably occurs quite regularly along the coast in Nov. and Dec. (and perhaps also in March) in such sparing numbers as to escape notice. The only specimen of this beautiful bird yet taken in this State, so far as I am aware, is the one shot by myself while collecting invertebrates, at low water, with my friend, Mr. S. F. Clark. "On Nov. 4th, 1875, while collecting along the beach at 'South End,' a few miles below New Haven, I was fortunate enough to secure a fine specimen of the Ipswich Sparrow (*Passerculus princeps* Maynard). The specimen was a female, and in excellent condition. Its mate was seen, but escaped capture."\* The day was cold and chilly, with occasional flurries of snow.

86. *Passerculus Savanna* (Wilson) Bonaparte. Savanna Sparrow.

An abundant summer resident, breeding in open fields and pastures. Arrives early in April, remaining, in large numbers, till after the middle of November.

\* Bull. Nutt. Ornithol. Club, vol. i, No. 2, p. 52. July, 1876.

87. *Poocetes gramineus* (Gmelin) Baird. Bay-winged Bunting; Grass Finch.

A common summer resident, breeding abundantly, like the last, in open fields. Arrives early in April (April 6, 1875 and same date 1877, Sage); remaining till about the middle of November.

88. *Coturniculus passerinus* (Wilson) Bonaparte Yellow-winged Sparrow.

A common summer resident in some parts of Connecticut (notably in the Connecticut Valley and along our southern border); not found at all in others. Arrives early in May. Frequents dry, sandy, treeless wastes. Linsley found it breeding here and at Stratford. "In the vicinity of Hartford, Conn., this bird appears also to be a not uncommon summer resident."\* Mr. Purdie states that "at Saybrook, Conn., its notes were to be heard in every field."† I have taken it near Savin Rock (May 29, 1877), and Mr. Grinnell tells me it is not uncommon about Milford, Conn. It also breeds about Portland, Conn. (Coe and Sage). I am informed by Messrs. Grinnell and Clark that it builds a beautiful covered nest, not unlike that of the Oven Bird (*Sivurus auricapillus*). Mr. Erwin I. Shores writes me that he has taken it at Enfield, Conn., in the northern part of the State, but in the Connecticut Valley, in July (July 6, 1874).

89. *Coturniculus Henslowi* (Audubon) Bonaparte. Henslow's Sparrow.

A rare summer resident. I am very glad to be able to include this species on the strength of a specimen just received from my friend Dr. F. W. Hall. He shot it at Killingworth, Middlesex Co., Conn., July 18th, 1873, and it is in the worn breeding plumage. I had searched in vain for it in the many collections of the birds of this State to which I have had access, and had really despaired of finding it at all. Many specimens have been taken in Massachusetts and it doubtless occurs regularly in the Connecticut Valley, if not in other parts of the State. Giraud says that on Long Island "it is not so rare as is generally supposed. In general, it frequents the low, wet meadows, and passes most of its time on the ground among the tall grass, and is exceedingly difficult to flush, even when pursued with dogs; it will not fly until nearly within their reach, when it starts from the ground, moves on only a few yards, and again drops among the grass."‡

\* Baird, Brewer and Ridgway, vol. i, p. 554.

† Bull. Nutt. Ornith. Club, vol. ii, No. 1, p. 17. January, 1877.

‡ Giraud's Birds of Long Island, p. 104. 1844.

90. *Ammodromus maritimus* (Wilson) Swainson. Seaside Finch.

A common summer resident, breeding abundantly in the salt and brackish water marshes near the coast. Remains into September.

91. *Ammodromus caudacutus* (Gmelin) Swainson. Sharp-tailed Finch.

A common summer resident, like the last, and breeds in the same situations. Arrives about the middle of April (Apr. 14, Osborne). Their eggs are laid during the last of May and first of June. Mr. Dayan found a nest containing four fresh eggs on May 31, 1876, at Savin Rock, and on the 7th of June both species were breeding abundantly. We found great numbers of both along the Quinnipiac River, and so far inland that the water was almost, if not quite, fresh. In some particular spots the *maritimus* outnumbers the *caudacutus*, but on the whole the latter greatly predominates.

92. *Melospiza palustris* (Wilson) Baird. Swamp Sparrow.

A common summer resident, breeding plentifully. Arrives early in April, remaining till late in November (Nov. 20).

93. *Melospiza melodia* (Wilson) Baird. Song Sparrow.

An abundant resident; particularly numerous from February to December, but not uncommon all through December and January. In the winter season they frequent old fences alongside which a copious growth of brushwood has sprung up; also found in backyards in the city. Mr. W. W. Coe, of Portland, Conn., found a Song Sparrow's nest in a hole in a tree ten feet from the ground (early June, 1873).\*

94. *Melospiza Lincolni* (Audubon) Baird. Lincoln's Finch.

A rather rare summer resident. Mr. J. N. Clark, of Saybrook, Conn., showed me a mounted specimen of this species which he had shot in a brush heap in his garden in the spring of 1875. He thinks he saw another a few days before, but it was very shy and he did not kill it. Mr. Erwin I. Shores, of Suffield, Conn., writes me that it is "not rare" in that vicinity, where he took one specimen in 1874, and three more this spring (1877). Mr. Shores says that on May 23, and again on June 2d, he "saw one with small twigs in its bill," hence, although he did not actually find the nest, there can be no reasonable

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\* MS. notes of W. W. Coe.

doubt of its breeding. He further states: "There is a small piece of woodland in this place where surely they cannot be considered rare. Have seen several that I've not been able to shoot. They are very shy. You just barely get a glimpse of one and have just time to get an idea of what it is, when down he goes into the thick shrubbery, and no amount of patient waiting will tempt him to come in sight again. Provoked, you determine to kill every one that comes in sight, and after the slaughter of half a dozen innocent Song or Swamp Sparrows, you conclude that that won't do. *Then*, perhaps, almost the first bird you leave will be Lincoln's Sparrow. I think they are much more common than generally supposed, but are so shy, and inhabit such bushy pastures, that they are hard to find."\* J. G. Ely, of Lyme, Conn., "took three this spring" (1877).

**95. *Junco hyemalis* (Linné) Selater.** Slate-colored Snowbird.

A common winter resident, arriving, from the north before the middle of October (Oct. 8, 1876, Osborne), and remaining till the first week in May (last seen May 2, 1877, Osborne; May 3, 1876).

**96. *Spizella monticola* (Gmelin) Baird.** Tree Sparrow.

A common winter resident, but more numerous in spring and fall. Arrives from the north about the last of October (Oct. 28, 1875), and remains till near the middle of April (Apr. 12, Osborne).

**97. *Spizella socialis* (Wilson) Bonaparte.** Chipping Sparrow.

An abundant summer resident, arriving as early as the latter part of February (Feb. 23, 1877, G. B. Grinnell), and remaining, in numbers, till the last of November. Sometimes places its frail nest on the ground, as well as on trees and bushes (Coe). A few sometimes spend the winter with the English Sparrows about town. They often awake in the night, sing once, and go to sleep again. Scarcely a night passes (in June and early July) but that I hear one sing several times—generally about midnight.

**98. *Spizella pusilla* (Wilson) Bonaparte.** Field Sparrow.

An abundant summer resident, generally breeding in open fields. Arrives early in April (Apr. 6, 1877, Portland, Conn., Sage), remaining till December (have taken it all through November and on Dec.

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\* MS. notes of Erwin I. Shores.

2, 1875). They are untiring songsters, particularly in early spring, and may be found everywhere except in dense woods. The song of the Field Sparrow is loud, clear, and pleasing, and he may consider himself fortunate, who has mastered its numerous variations. Minot says of it, "No sounds are more refreshing, on a warm afternoon of early summer, than those which they produce." It nests both on the ground and in low bushes.

99. *Zonotrichia albicollis* (Gmelin) Bonaparte. White-throated Sparrow.

Abundant during the migrations, sometimes remaining all winter. Arrives from the north about Sept. 22d, remaining through November. Returns in April and departs about May 20, at which date it was last seen, both in 1876 and 1877. During the winter of 1874-5 they were very numerous all about the city, as well as in the surrounding country. Mr. Erwin I. Shores, of Suffield, Conn., writes me that on May 15, 1877, they were extremely abundant in the woods in his vicinity—outnumbering all the other species together.

100. *Zonotrichia leucophrys* (Forst.) Sw. White-crowned Sparrow.

An irregular migrant; sometimes quite common. (Nov. 28 and Dec. 5, 1874; Oct. 25, 1877, common.) Mr. Dayan shot a beautiful specimen May 10, 1876. Mr. Osborne saw it on May 15, 1877. Mr. W. W. Coe shot one at Portland, Conn., March 20, 1875.

101. *Passer domesticus* Brisson. English Sparrow; House Sparrow.

Introduced. An abundant resident in all the larger, and most of the smaller, towns throughout the State. The opening sentence, under the head of this species, in H. E. Dresser's magnificent work on "The Birds of Europe," shows that its habits have remained unchanged, in one respect at least, notwithstanding the great distance it has been carried, and the varied conditions to which it has been subjected: "Throughout Europe the House Sparrow is very generally distributed almost wherever there are human habitations (except in the extreme north); for it follows the footsteps of man almost like a domestic animal, and where he fixes his habitation there the Sparrow also takes up its abode." Their pugnacity seems to vary in different parts of the country and at different times of the year. In New Haven their attitude toward other species is not generally offensive, and they are commonly seen on the friendliest terms with the Chipping Sparrows, throughout the entire season. In early spring I have

observed them feeding quietly with the Red-poll Warblers (*Dendroeca palmarum*) on the City Green, and in fall it is no uncommon thing to find them associated with *Passerella iliaca*, *Zonotrichia albicollis*, *Melospiza melodia*, and *Spizella socialis* and *pusilla*, without showing the slightest sign of animosity. In New York and other cities, however, they are sometimes quite belligerent, attacking and driving off the birds that once occupied the same ground. This is especially noticeable in spring, when they appropriate the houses put up for Bluebirds, Wrens, and other species. That they do some good in destroying injurious insects is certain. "In open places where there are a few trees in the towns, such as the gardens in the squares or in the parks, it is eminently useful in ridding the foliage of the insects which would otherwise destroy the leaves and tender shoots; . . . . . and destroys myriads of the small smooth caterpillars and larvæ which feed on the buds of the trees, and is one of the best guardians of the orchard."\* A few days ago my attention was attracted by the peculiar actions of one of these Sparrows. It was hopping along on the uppermost rod of a fence, and whenever it came to a post (into which the fence rods were inserted) it would stand on tip-toe and peep up under the ornamental top-board of the post, as if looking for something. On coming nearer I discovered that the bird was searching for moths, of which it secured one or more at each post, and, after proceeding in this manner for several rods, it flew away, evidently having had enough for one meal. In passing the fence since, I have, on several occasions, seen a Sparrow, apparently and probably the same individual, going through with precisely the same procedure, and with the same result. Do not cases like the above go far to prove that many birds are highly intelligent and possess a good degree of memory? The Sparrow in question discovered a moth, doubtless by accident, concealed beneath the overlapping edge of the top-board of a fence-post. Was he content with simply gobbling this one up? By no means; if there is one there may be more, and sure enough he soon spies another, and, going to the next post, still another, and so on till he is satisfied. Next day, when searching for breakfast, does he forget yesterday's experience? Not at all; he returns to the fence-posts and readily secures another meal. The chance finding of the first moth has led to the knowledge that similar insects take refuge, by day, in certain places; and in the

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\* A History of the Birds of Europe, including all the species inhabiting the West-European Palæarctic Region. By H. E. Dresser. Part XLVIII, March, 1876.

establishment of a regular habit of searching for them. In spring, when the trees are in flower, and the swollen buds give place to tender green leaves, the House Sparrows join the early Warblers in running about among the branches in pursuit of one another as well as of the small beetles that come there to feed upon the fresh foliage. But so far as the accomplishment of the object for which they were imported, viz., the extermination of the canker worm (*Anisopteryx vernata* and *A. pometaria*) in our larger towns and cities, they have most signally failed. That they occasionally devour the full-grown moth can not be doubted; neither do I feel justified in denying that they sometimes eat the worms themselves, though I have never seen them touch one—not even when hopping about in the midst of hundreds of canker worms. They seem to prefer the small beetles and seeds abounding in the horse droppings about the streets. It is true that there was a great diminution in the ranks of the canker worms soon after the introduction of the House Sparrows, but I am informed that this was due to a parasite (*Platygaster*) which preyed upon and destroyed great numbers of the worms by depositing its eggs in the eggs of the canker worm moth, and not, as generally supposed, to the Sparrows. It may, perhaps, be considered as somewhat of a digression in a mere local list like this, to devote so much space to the biography of a species, but I believe that notes recording actual observations on the habits of any bird should always prove acceptable, especially when there is difference of opinion, resulting in controversy, regarding the merits of a species, for in this way the possibility that individuals, or colonies, may differ in habits in different localities, or at different seasons, is suggested, and warns us not to be too dogmatic in our statements, or too hasty in drawing conclusions.

For abundant and unquestionable evidence of the pugnacity and disagreeable qualities of this bird, in some sections, see the writings of Coues, Gentry, and others. Vermont de Bomare, writing in 1791, says: "In Brandebourg, in order to diminish the ravages committed by Sparrows, a price is set on their heads, and the peasants are compelled by law to bring in a certain number yearly; in each village there are Sparrow hunters who sell the birds to the peasants to enable them to pay their tribute. . . . It follows the farmer while sowing, harvesting, threshing, or feeding his poultry; it enters the Dovecot, and with its bill pierces the throats of young pigeons, to obtain the grain in their craw."\*

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\* Quoted by Charles Pickering in *Proceed. Bost. Soc. Nat. Hist.*, vol. xi, p. 158, April 17, 1867.

The English House Sparrow was first introduced into New England, so far as I am aware, in the fall of 1858, when "Six birds were set at liberty in a large garden" in the city of Portland, Maine. "They were introduced into Boston by the city government in 1868,"\* and have since spread over the greater part of New England.

102. *Passerella iliaca* (Merrem) Swainson. Fox-colored Sparrow.

Common during the migrations, arriving from the North during the middle or latter part of October (Oct. 10, 1876, Osborne; 23, 1877), and remaining about a month (Nov. 20). Have taken it, in spring, from March 6th to April 19th. Gregarious. The largest and surely one of the handsomest of our Sparrows. Speaking of its song, Dr. Brewer says: "His voice is loud, clear, and melodious; his notes full, rich, and varied; and his song is unequalled by any of this family that I have ever heard."

103. *Euspiza Americana* (Gmelin) Bonaparte. Black-throated Bunting.

Dr. Linsley, in his "*Catalogue*," takes particular pains to state that this species was "very common" at New Haven (p. 261), but I have never seen it here and can find no other record of its capture in this State. It must be regarded as very rare in New England, although several have been taken, breeding, in Massachusetts. Its former abundance and present scarcity in this section affords another excellent example of the irregular migrations of birds. Giraud gave it as breeding commonly on Long Island,† but says the eggs are "white, speckled with black," whereas they are blue, unmarked.

104. *Goniaphea Ludoviciana* (Linné) Bowditch. Rose-breasted Grosbeak.

A common summer resident, breeding in dense undergrowth. Arrives before the middle of May (May 11, 1874, Portland, Conn., Sage), and I shot a female as late as Nov. 25th, (1874), in the city. I am informed by Prof. G. Brown Goode, of Middletown, Conn., that he knew an individual of this species to live eighteen years in confinement. Mr. J. Hammond Trumbull tells me that it was almost unknown about Hartford, Conn., thirty-five years ago.

NOTE.—*G. caerulea* probably occurs as an accidental visitant from the South. It has been taken on the Island of Grand Menan,‡ and

\* Birds of North America, Baird, Brewer & Ridgway, vol. i, p. 526, 1874.

† Birds of Long Island, p. 100. 1844.

‡ Herrick's Partial Catalogue of the Birds of Grand Menan, p. 8. 1873.



Mr. Boardman states that it was "common in the spring of 1861" in the vicinity of Calais, Maine!\*

105. *Cyanospiza cyanea* (Linné) Baird. Indigo Bird.

A common summer resident, breeding, like the last, in thick patches of bushes. Arrives before the middle of May (May 14, 1874, J. H. Sage; 14, 1876, Osborne; 14, 1877, C. H. M.; also May 9, 1875, Sage), remaining into September.

106. *Cardinalis Virginianus* (Brisson) Bonaparte. Cardinal Grosbeak.

A rare and accidental summer visitor from the South. Mr. Thomas Bostwick of this city found one lying dead during the summer of 1874, and Mr. Geo. Bird Grinnell, who examined the specimen, tells me that its bill and feet, as well as the plumage, proved it to be a wild bird. Numerous specimens have, from time to time, been taken or seen along the Connecticut Valley, and it is highly improbable that they were all escaped cage birds. My friend, Mr. E. P. Bicknell, has taken a number of individuals about Riverdale, Westchester Co., N. Y., and it is certain that most, if not all, of them were wild.

Regarding the age to which our small birds attain, it is worthy of mention that my grandmother kept a Cardinal Bird caged for twenty-one years—it was noisy to the last. Its colors began to fade several years before its death, till finally it looked very like a worn female.

It winters as far north as southern New Jersey and Pennsylvania (Turnbull).†

107. *Pipilo erythrophthalmus* (Linné) Vieillot. Chewink; Towhee Bunting.

A common summer resident, breeding on the ground, in undergrowth, and in the woods. Arrives early in May (May 1, 1876, Osborne; 4, 1877), remaining till November (Oct. 28, Nov. 8.) Mr. J. H. Sage has a fine male in his cabinet which was shot near Portland, Conn., Jan. 22<sup>d</sup>, 1876! A characteristic nest, found May 24th, 1874, "under a Virginia Juniper," by the Stadtmüller Brothers, "was composed externally of cedar bark, lined with grass and horse hair."‡

\* Proceed. Bost. Soc. Nat. Hist., vol. ix, p. 127. 1862.

† The Birds of Eastern Pennsylvania and New Jersey. By Wm. P. Turnbull, LL.D. p. 24. 1869.

‡ MS. notes of the Stadtmüller Brothers.

## Family, ICTERIDÆ.

108. *Dolichonyx oryzivorus* (Linné) Swainson. Bobolink; Reed-bird,  
Rice-bird.

A common summer resident, breeding in meadows. Arrives before the middle of May (May 7, 1876, Osborne; same date at Portland, Sage; May 12, 1877).

109. *Molothrus pecoris* (Gmelin) Swainson. Cow-bird.

An abundant summer resident, arriving in March or early in April and remaining till November (Nov. 4, 1874). Sometimes winters. Mr. Geo. Bird Grinnell writes me that he took it twice in mid-winter (Jan. 15, 1874, and Jan. 16, 1875).

110. *Agelæus phoeniceus* (Linné) Vieillot. Red-winged Blackbird.

A common summer resident, breeding abundantly in swampy places. Sometimes winters. Arrives during the latter part of February or early in March (March 4), remaining till late in the fall. Though generally choosing clumps of bushes for their characteristic nests, they sometimes place them on the ground. On the 6th of June, 1876, Mr. Dayan and myself, while collecting on a part of the Quinipiac marshes where there were no bushes, found several nests containing fresh eggs. The nests were extremely shallow—very unlike those commonly found in bushes—and were placed on the bare ground, in the grass, with no attempt at concealment. I am informed by Mr. Grinnell that he has taken it in January (Jan. 15, 1874, and Jan. 16, 1875). This is the bird concerning which Josselyn wrote (in 1675) that there were, in New England, "*Starlings* black as *Ravens* with scarlet pinions."\* Mr. W. W. Coe once wounded one of these birds (probably striking it in the head) which "started into the air and kept going up—up—up—sailing in larger circles—still ascending till lost to sight."†

111. *Sturnella magna* (Linné) Baird. Meadow-lark.

Resident, but particularly abundant from early spring till late in the fall. A few small flocks winter along the coast. The Rev. Mr. Peabody observes that this bird "has few enemies excepting Hawks, snakes, and young sportsmen."

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\* An Account of two Voyages to New England, p. 100. 1675.

† MS. notes of W. W. Coe.

112. *Icterus spurius* (Linné) Bonaparte. Orchard Oriole.

A common summer resident, breeding chiefly in orchards. Arrives during the first week in May (May 7, 1876, Osborne).

113. *Icterus Baltimore* (Linné) Daudin. Baltimore Oriole.

A common summer resident, breeding plentifully in the city as well as country throughout the State. Arrives about May 10th. Have taken it on the 8th, and Mr. Osborne saw one as early as the 6th (1876), while this year (1877) it did not come, in any numbers, till the 13th, when the whole country was literally "alive with them." Mr. J. H. Sage saw it at Hartford, May 6th, 1868 and 7th, 1872; also at Portland, Conn., May 7th, 1876, and May 10th, 1874 and 1875.

114. *Scolecophagus ferrugineus* (Gmelin) Swainson. Rusty Grackle.

Abundant during the migrations, sometimes wintering. Arrives before the middle of February (Grinnell) remaining through March into April (April 19, Osborne). In the fall it returns before the middle of September (Sept. 11, 1875 several flocks seen), remaining into November. Mr. Grinnell informs me that he took it, at Milford, Conn., Jan. 16th and 29th, and Feb. 6th, 1875.

115. *Quiscalus purpureus* (Linné) Licht. Crow Blackbird.

A common summer resident, breeding in evergreen trees in the city, as well as outside. Arrives about March 1st, though a few are generally seen in February (Feb. 13, 1876). Departs in November.

Such was the abundance, in early colonial times, of some of our commoner, and at present harmless, birds, that "premiums were paid by the local governments for the destruction of many of these species, and not without cause."\* The town of Lynn, on March 8th, 1697, voted "that every householder in the town, should, sometime before the fifteenth day of May next, kill or cause to be killed, twelve blackbirds, and bring the heads of them, at or before the time aforesaid, to Ebenezer Stocker's, or Samuel Collins's, or Thomas Burrage's, or John Gowing's, who are appointed and chose by the town to receive and take account of the same, and take care this order be duly prosecuted; and if any householder as aforesaid shall refuse or neglect to kill and bring in the heads of twelve blackbirds, as aforesaid, every

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\* J. A. Allen in Bull. Nutt. Ornith. Club, vol. i, No. 3, p. 54. Sept., 1876.

such person shall pay three pence for every blackbird that is wanting, as aforesaid, for the use of the town.”\*

Peter Kalm, in his “Travels into North America,” thus speaks of their depredations: “A species of birds, called by the Swedes, maize-thieves, do the greatest mischief in this country. They have given them that name, because they eat maize, both publicly and secretly, just after it is sown and covered with ground, and when it is ripe. The English call them blackbirds. There are two species of them, both described and drawn by Catesby.† Though they are very different in species, yet there is so great a friendship between them, that they frequently accompany each other in mixed flocks. However, in Pennsylvania, the first sort are more obvious, and often fly together without any of the red-winged stares. . . . Their chief and most agreeable food is maize. They come in great swarms in spring, soon after the maize is put under ground. They scratch up the grains of maize and eat them. As soon as the leaf comes out, they take hold of it with their bills, and pluck it up, together with the corn or grain; and thus they give a great deal of trouble to the country people, even so early in spring. To lessen their greediness of maize, some people dip the grains of that plant in a decoct of the root of the *veratrum album*, or white hellebore, (of which I shall speak in the sequel), and plant them afterwards. When the maize-thief eats a grain or two, which are so prepared, his head is disordered, and he falls down: this frightens his companions, and they dare not venture to the place again. But they repay themselves amply towards autumn, when the maize grows ripe; for at that time they are continually feeding. They assemble by thousands in the maize-fields, and live at discretion. They are very bold; for when they are disturbed, they only go and settle in another part of the field. In that manner, they always go from one end of the field to the other, and do not leave it till they are quite satisfied. They fly in incredible swarms in autumn; and it can hardly be conceived whence such immense numbers of them should come. When they rise in the air they darken the sky, and make it look quite black. They are then in such great numbers, and so close together, that it is suprising how they find room to move their wings. I have known a person shoot a great number of them on one side of a maize-field, which was far from frightening the rest; for they only just took flight, and dropped

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\* History of Lynn, by Alonzo Lewis and James R. Newhall, p. 298.

† See Catesby's Nat. Hist. of Carolina, vol. i, tabs. 12 and 13.

at about the distance of a musket-shot in another part of the field, and always changed their place when their enemy approached. They tired the sportsman, before he could drive them off the maize, though he killed a great many of them at every shot. They likewise eat the seeds of the *aquatic ture-grass* (*Zizania aquatica*) commonly late in autumn, after the maize is got in. I am told, they likewise eat buck-wheat, and oats. Some people say, that they even eat wheat, barley, and rye, when pressed by hunger; yet, from the best information I could obtain, they have not been found to do any damage to these species of corn. In spring, they sit in numbers on the trees, near the farms; and their note is pretty agreeable. As they are so destructive to maize, the odium of the inhabitants against them is carried so far, that the laws of *Pennsylvania* and *New Jersey* have settled a premium of three pence a dozen for dead maize-thieves. In *New England*, the people are still greater enemies to them; for Dr. *Franklin* told me, in the spring of the year 1750, that, by means of the premiums which have been settled for killing them in *New England*, they have been so extirpated, that they are very rarely seen, and in a few places only. But as, in the summer of the year 1749, an immense quantity of worms appeared on the meadows, which devoured the grass, and did great damage, the people have abated their enmity against the maize-thieves; for they thought they had observed that those birds lived chiefly on these worms before the maize is ripe, and consequently extirpated them, or at least prevented their spreading too much. They seem therefore to be entitled, as it were, to a reward for their trouble.”†

NOTE.—The Boat-tailed Grackle (*Quiscalus major*, Vieillot) has been accredited to New England by Linsley and others, but an unusually large Crow Blackbird was probably mistaken for it.\*

### Family, CORVIDÆ.

#### 116. *Corvus Americanus* Audubon. Common Crow.

An abundant resident; generally lays five eggs and sometimes six (Coe). On the 25th of January, 1875, I saw a flock of several hundred Crows near New Haven. “It is related of a certain ancient philosopher, walking along the sea-shore to gather shells, that one of

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\* Peter Kalm's Travels into North America, vol. ii, pp. 73-78. 1771.

† See Cones' Birds of the Northwest, p. 204. 1874

these unlucky birds, mistaking his bald head for a stone, dropped a shell-fish upon it, and thus killed at once a philosopher and an oyster.”\*

117. *Corvus ossifragus* Wilson. Fish Crow.

This species must be regarded as a rare summer visitor so far north as this State, although it has been seen in Massachusetts by Mr. William Brewster, who writes: “On the morning of March 16th, 1875, I saw a bird of this species flying swiftly over our place in Cambridge. It was pursued by at least twenty-five or thirty of our common species (*Corvus Americanus*), and at each renewal of their attacks gave utterance to its peculiar and unmistakable notes.”† Linsley gave it as occurring at “Stratford,” Conn.‡

118. *Cyanurus cristatus* (Linné) Swainson. Blue Jay.

An abundant resident; frequently seen about the city.

Family, TYRANNIDÆ.

119. *Tyrannus Carolinensis* (Linné) Temminck. King-bird; Bee-bird.

A common summer resident, arriving early in May (Mr. Dayan informs me that he saw one as early as April 13, 1877). Departs about the middle of September (Sept. 15) or later. Mr. Sage has twice seen it at Portland, Conn., as early as May 7th (1864 and 1876) and once on the first (1877), but it generally comes on the 10th.

The habit, so characteristic of this species, of attacking, and driving away from the vicinity of its nest, Hawks, Crows, and other large birds, early attracted attention, for we find, in Josselyn's Voyages to New England (published in 1675, p. 96), the following account of it: “There is a small Ash-color Bird that is shaped like a *Hawke* with talons and beak that falleth upon *Crowes*, mounting up into the air after them, and will beat them till they make them cry.”§ The description of the bird would fit a Shrike even better than the one in question were it not that it “falleth upon Crows” which pastime this bird is not supposed to indulge in; still I have seen a Northern

\* Nuttall's Manual of Ornithology, vol. i, p. 211. 1832.

† Bull. Nutt. Ornith. Club, vol. i, No. 1, p. 19. April, 1876.

‡ Am. Jour. Sci. and Arts, vol. xlv, No. 2, p. 260. April, 1843.

§ Reprinted in Collections of the Mass. Historical Society, vol. iii, 3d series, p. 275. 1833.

Butcher Bird chase a Barred Owl for the space of half an hour, closely following him to and fro through the woods, till I put an end to his misery by shooting both.

120. *Milvulus forficatus* (Gmelin) Sw.      Swallow-tailed Flycatcher.

An extremely rare accidental visitor. The only record of its capture in this State is that recently published by Mr. H. A. Purdie: "Mr. Jencks informs me that a specimen of this species was shot by Mr. Carpenter, at Wauregan, Conn., about April 27, 1876. The bird first attracted Mr. Carpenter's attention by its opening and closing the tail while flying about a small sheet of water in quest of insects. The only other Eastern United States capture of this species, is a male taken at Trenton, New Jersey, a few years ago, as recorded by Dr. C. C. Abbott."\* Dr. Abbott's specimen was shot on the 15th of April, 1872, and "when captured, was busily engaged in picking semi-dormant insects from the bark of the trees; creeping about very much as is the custom of *Certhia familiaris*, and all the while opening and shutting the long scissor-like tail."† Its proper habitat is the lower part of the Mississippi Valley and Texas, thence southward into South America.

121. *Myiarchus crinitus* (Linné) Cabanis.      Great-crested Flycatcher.

A common summer resident, generally placing its well-known snake-skin-lined nest in the hollow limb of some old apple tree, or rotten fence-post. Arrives early in May (May 8, 1873, Hartford, Sage), and Mr. W. W. Coe has taken its nest (four eggs) as late as June 13th, (1873). The history of this bird affords us a remarkably good example of the change in habitat of a species during a comparatively brief period of years.

Mr. T. Martin Trippe, in one of his interesting articles on "The Irregular Migrations of Birds,"‡ thus details his experience with the bird in question: "In a series of several years close observation at Orange, New Jersey, I searched for the Great-crested Flycatcher (*Myiarchus crinitus*), year after year, but all in vain; and what made the fact very singular was, that twelve or fifteen miles off, I had seen the bird sufficiently often to convince me that if not common, it was by no means rare. Yet for some inexplicable reason it did not

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\* Bulletin Nuttall Ornithological Club, vol. ii, No. 1, p. 21, Jan., 1877.

† American Naturalist, vol. vi, No. 6, p. 367, June, 1872.

‡ Am. Nat., vol. vii, No. 7, p. 390-91, July, 1873.

inhabit the country immediately about Orange, for, although in the woods nearly every week for years, I never saw it until, after I had almost despaired of ever finding it, I did succeed in shooting a single specimen. This was in the fall; the next spring I saw a pair . . . ., and, after an absence of two years, returning to Orange, I strolled through the woods, my old hunting grounds, and, to my surprise, almost the first bird I saw was the Great-crested Flycatcher. Subsequently I scarcely ever took a walk through the woods without seeing or hearing it." A precisely parallel case occurred in the vicinity of my home in Lewis County, northern New York. There, prior to the year 1870, they were unknown, at least so far as I can ascertain, and it is safe to say that they were extremely rare. In 1870 my cousin, Mr. C. L. Bagg, shot one specimen, the first we had ever seen. During the next season I shot a pair. I was away from home in 1872, but Mr. Bagg informs me that he took several Great-crested Flycatchers that year, and that they were quite common. In August, 1873, I shot eight in about an hour's time, and since then they have been one of our commonest species, breeding abundantly in the tall maple and birch forests, where their characteristic, but rather harsh cry, may be heard at any hour of the day throughout the entire season.

Regarding its former scarcity in Connecticut, Linsley said "a specimen of the Great-crested Fly-catcher was shot by me in the spring of 1838, in my front yard, the only living individual of this bird I have ever seen in this State,"\* and Nuttall observed that it was "nearly unknown in New England."† That it is now really a common bird in *southern* Connecticut, at least, is certain. However, we must take into consideration the fact that these gentlemen (Nuttall and Linsley) were probably not familiar with its characteristic—I may even say diagnostic—note, and my experience with the bird has been that it is rarely seen, unless, guided by its note, it is persistently followed up, and even then one is often at his wits end to get a shot, so well does the bird keep concealed amongst the foliage. And surely it is not particularly conducive to tranquillity of mind to stand, up to one's knees in water, amidst myriads of mosquitoes, in a hot day in summer, gazing intently up into a tall tree, where, directly overhead, the cry of the Great-crested Flycatcher is constantly heard, and yet the most careful search fails to reveal the exact where-

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\* Am. Jour. Sci. and Arts, vol. xliv, No. 2, p. 259, April, 1873.

† Manual of the Ornithology of the United States and Canada. By Thomas Nuttall. Vol. i, Land Birds, p. 271, 1832.



abouts of its author; and, when one's neck is nearly broken, to hear the cry again, this time issuing from another and still deeper portion of the swamp.

In support of this view I now propose to bring forward pretty conclusive proof: Mr. W. W. Coe, who early became familiar with the note of this species, tells me that it has been a common bird in the vicinity of Portland, Conn., for at least fifteen years—ever since he commenced collecting birds. Prof. William D. Whitney, of New Haven, on inquiry, informs me that he has known the bird for at least thirty years, and that he has always regarded it as common. His observations extend over portions of Massachusetts (about Northampton) as well as Connecticut. Mr. J. N. Clark, of Saybrook, Conn., says that it was not rare, about the mouth of the Connecticut, twenty-five years ago; and Dr. Wm. Wood, of East Windsor Hill, Conn., tells me that it has bred regularly, and has not been uncommon, in that vicinity, for the last twenty-five or thirty years.

In the face of these facts what is to be done? For my own part, I am willing to admit that in northern New York the bird may not have been rare prior to the year 1870 (although I feel pretty sure that this was not the case), and that it escaped notice because I was then unfamiliar with its note. In New Jersey, however, a similar supposition will not hold, for Mr. Trippe *was* familiar with its note and habits, from observations in a neighboring district, and asserts positively that it suddenly became abundant in a locality where before it was nearly, if not quite, unknown. Hence it is only fair to conclude that, while some of the supposed cases of change of habit may be explained on the ground that the observers were not sufficiently familiar with the bird, yet there are others concerning which the proof is ample, and the *cause* of the change only remains to be accounted for. Whether this be due to changed conditions in the physical features of the country (such as the cutting away of timber, drying up of streams and swamps, etc., for example), or to an increase in some species of insects on which the bird feeds (caused perhaps by the abundance of some particular food-plant—due, may be, to altered climatic conditions), or to an actual increase in the number of birds themselves, I will not take upon myself to decide, so imperfect is the present state of our knowledge on these points.

122. *Sayornis fuscus* (Gmelin) Baird. Pewee Flycatcher; Phoebe-bird.

A common summer resident. Comes very early: Dr. F. W. Hall tells me he saw it on Feb. 25th. 1876, and Mr. Osborne saw one March

11th of the same year. I first noticed it on the 24th of March this season (1877); and Mr. Sage found it at Portland, Conn., on the 30th. In the fall it remains till, or after, the middle of October (Oct. 7, 1874; Oct. 13, 18, 1875). Breeds abundantly under the gable-ends, or on exposed beams, of houses and outbuildings, in old sheds, and under bridges. The primitive habit of building on the side of some rocky cliff is still adhered to in some parts of the State, and the most beautiful nest I have ever seen was found by Prof. Daniel C. Eaton and myself, while botanizing near Mt. Carmel, on the 23d of May, 1875. It was placed in a small wedge-shaped niche in the face of the rock, and its exterior was composed entirely of delicate green mosses. It contained five pure white, unspotted, fresh eggs. Another beautiful nest, similarly placed, was found on the "Hanging Hills of Meriden," by my friend, Mr. William H. Patton, on the 12th of May, 1877. It contained four fresh eggs, one of which is distinctly sprinkled, chiefly at the larger end, with small brownish-red spots. It also breeds on the faces of Pine and West Rocks near New Haven.

123. *Contopus borealis* (Swainson) Baird. Olive-sided Flycatcher.

Rare; probably a few sometimes breed in the more northern and hilly portions of the State, as they are known to do in Massachusetts. Not previously recorded from Connecticut, except by Linsley, who gave it, with a query, from Stratford. On the 18th of October, 1875, attracted by its characteristic note, "which is a short whistle resembling the syllables *O-whêê*, *O-whêê*, *O-whêê*," uttered several times in succession, "with the accent on the *whê*, and the voice falling on the last *ê*,"\* I caught a momentary glimpse of one, perched on the top of a tall tree; but the bird was very shy and I did not succeed in getting a shot. Mr. Erwin I. Shores writes me that he took a male at Suffield, Conn., August 5, 1874. This is strong evidence of their breeding in the hills about that portion of the State, for migrants would hardly appear in Connecticut during the *first* of August. On turning to my manuscript notes on the birds of Easthampton, Mass., I find the following: "Breeds. Not so rare as it should be. Four specimens procured: one shot Sept. 10, 1873, and another May 23, 1874, in a small grove of pines northwest of town; two shot May 28, 1874, on Mt. Nonotuck [part of Mt. Tom], where they appear to be quite common. Their alimentary tracts contained coleopterous insects,

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\* Am. Nat., vol. vii, No. 12, p. 750, Dec., 1873.

wasps, and humble-bees." In Prof. Whitney's private collection, and in the beautiful cabinet of mounted birds presented by him to the Peabody Museum of Yale College, are two or three specimens of this bird, which he killed in the vicinity of Northampton, Mass., some years ago—one as late as June 4th, (1846). Mr. Ruthven Deane writes: "During the past three or four years I have observed each year several specimens of this beautiful Flycatcher in the vicinity of Cambridge, Mass., and, although I consider this a rare bird with us, I am inclined to think a few breed within the limits of the State every year."\* The species was described by Nuttall, from specimens taken in the vicinity of Cambridge, "in the woods of Sweet Auburn," in June, 1830 and 1831, and it has since been observed in eastern Massachusetts by Audubon (1832), Welch (1858), Brewster, Maynard, Cabot, Minot, and others. Nuttall says that his friend, W. Cooper, Esq., "received this bird likewise the preceding summer from the vicinity of Cape May, and Egg-harbor, in New Jersey,"† but Turnbull gives it as "very rare" in eastern Pennsylvania and New Jersey, and states that it only occurs as a migrant, being "generally seen early in May on its way north, . . . returns in September."‡ The occurrence in New Jersey, in "summer" (the month is, unfortunately, not stated) would indicate its breeding there, which hardly seems credible from what is now known concerning its distribution, though it is true that the "Pine-barrens" would afford it many congenial spots for nesting. Concerning their habits in the Adirondack region, in northern New York, where they breed plentifully, I have already observed that "they all seemed to have the same habit of choosing a large hemlock tree with a few dead branches on top, and were sure to light on the uppermost twig."§ Messrs. Maynard and Brewster gave it as "quite common and breeding at Umbagog," Maine, where "it has the habit of perching on dead stubs on the edge of clearings."|| Professor Verrill gave it as a "summer visitant, not very common,"¶ at Norway, Maine (about forty miles south of

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\* Am. Nat., vol. viii, No. 5, p. 308, May, 1874.

† Manual of Ornithology, p. 284, 1832.

‡ The Birds of Eastern Pennsylvania and New Jersey, by William P. Turnbull, 1869.

§ Am. Nat., vol. vii, p. 750, Dec., 1873.

|| A Catalogue of the Birds of Coos Co., N. H., and Oxford Co., Me., by C. J. Maynard, with notes by William Brewster. From Proceed. Boston Soc. Nat. Hist., vol. xiv, p. 21, Oct. 18, 1871.

¶ Catalogue of the Birds found at Norway, Oxford Co., Me., by A. E. Verrill. From Proceed. Essex Institute, vol. iii, p. 144, May, 1863.

Umbagog), and Prof. Charles E. Hamlin also observed it, in Kennebec County, in the same State.\* Dr. W. H. Gregg found that it was "not a very common species" near Elmira, Chemung Co., southern New York, "where he met with only two specimens during several years of bird collecting."† In central Ohio it is, according to the high authority of Dr. J. M. Wheaton, a "rare migrant."‡ The record of its occurrence in the east, south of New Jersey, is not well authenticated. My friend, Mr. E. P. Bicknell, informs me that he has taken several specimens "and saw six or seven individuals between August 21st and Sept. 26th, 1876, at Riverdale, Westchester Co., N. Y.

Now, on the other hand, on going northward, we find it breeding at Randolph, Vermont (Chas. S. Paine),§ and Mr. Osborne has seen it about Mt. Washington. "Audubon found it in Maine, on the Magdeline Islands, and on the coast of Labrador,"|| as mentioned by Dr. Brewer, who further states that "Mr. Boardman reports the Olive-sided Flycatcher as having of late years been very abundant during the summer in the dead woods about the lakes west of Calais [eastern Maine] where formerly they were quite uncommon," and that he is informed by Mr. Hoy "that this species used to be quite common near Racine [Wisconsin], frequenting the edges of thick woods, where they nested."

From the above references it will be seen that the Olive-sided Flycatcher belongs, in the east, to the Canadian fauna, while it occasionally extends down into the Alleghanian, and, if Cooper's record can be relied on, stragglers have been known to breed in the Carolinian. Going westward, however, the case is quite different, and we find *Contopus borealis* breeding in numbers from the "Cumberland House, on the Saskatchewan, in latitude 54°,"¶ where it was obtained by Sir John Richardson, and described by Swainson in 1831 (this description having priority over Nuttall's, which was not published till 1833), to Camp Bowie, Arizona, latitude 32°, "within one hundred miles of Mexico," where both "young and old were secured in

\* Report Sect. Maine Board Agriculture, p. 170, 1865.

† Catalogue of the Birds of Chemung Co., N. Y., by W. H. Gregg, M.D. From Proceed. Elmira Academy of Sciences, 1870.

‡ The Food of Birds as related to Agriculture, by J. M. Wheaton, M.D. From Ohio Agricultural Report, p. 8, 1874.

§ Appendix to Zadock Thompson's History of Vermont, p. 21. 1853.

|| History N. Am. Birds, Baird, Brewer and Ridgway, vol. ii, p. 354.

¶ Coues, Birds of the Northwest, p. 244. 1874.

August," by my friend, Mr. H. W. Henshaw, who, in his recent excellent work on the birds of that region, observes that "Its favorite perching places are the tops of the high pine stubs. From these stations it makes frequent sallies after passing insects, and seems rarely to miss its prey. When thus engaged, the clicking noise of its bill may be heard quite a distance. About the first of June, in southern Colorado, they had all mated, and each pair maintained a most jealous watch over the neighborhood chosen as its summer residence, never allowing the intrusion of the larger birds to pass unnoticed. The loud call notes of the male are, at this season, almost incessantly repeated."\* Mr. Henshaw also states that "specimens were taken near Camp Apache [Arizona] in July, which doubtless were breeding," and that he "found it almost as numerous in eastern Arizona, quite far to the south, as in Colorado."

Numerous specimens have been taken in Colorado by Allen,† Henshaw, Aiken, Trippe, and others. Regarding its occurrence at Idaho Springs, Colorado, T. Martin Trippe writes Dr. Cones that "It is quite uncommon, only three or four pairs having been observed throughout the summer, and these at widely different points, each pair apparently monopolizing a wide range. It keeps in the tops of the trees, and is an active flycatcher; its noise is loud and distinct; and its nest is placed in the top of a pine, and jealously guarded from all intrusion with as much fierceness and energy as the Kingbird's."‡ It is given by Snow as "rare in western Kansas."§ Notices of its occurrence in Utah have been published by Allen "several seen among the cottonwoods along Weber River",|| Henshaw,¶ Ridgway "breeding in Parley's Park, Wahsatch Mts.",\*\* Nelson (who "obtained one specimen from the top of a dead pine," among the mountains, thirty miles south of Fort Bridger),†† and myself;‡‡

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\* Report upon the Ornithological Collections made in portions of Nevada, Utah, California, Colorado, New Mexico and Arizona, during the years 1871, 1872, 1873 and 1874. By H. W. Henshaw. Forming Chapter III of the Zoological Volume published under the direction of Lieut. Geo. M. Wheeler, in charge of the Geographical and Geological Explorations and Surveys west of the 100th meridian. p. 350. Washington. 1875.

† Bulletin Museum Comp. Zool. Cambridge, vol. iii, No. 6, p. 158. 1872.

‡ In Cones' Birds of the Northwest, p. 245. 1874.

§ Catalogue of the Birds of Kansas. By F. H. Snow. 3d ed., p. 8. 1875.

|| Bull. Mus. Comp. Zool. Cambridge, vol. iii, No. 6, pp. 169, 179. 1872.

¶ Report upon Ornithological Specimens, pp. 22, 46. Wash. 1874.

\*\* Bull. Essex Inst., vol. vii, No. 2, p. 33. Feb., 1875.

†† Proceed. Boston Soc. Nat. Hist., vol. xvii, p. 344. Jan., 1875.

‡‡ Sixth Annual Report U. S. Geol. Survey of the Territories for the year 1872. p. 691.

and it was taken in Nevada by Bischoff (recorded by Henshaw), and Ridgway,\* who writes me as follows: "Although I found it at very few localities, I am certain of its occurrence wherever suitable localities exist. . . . It there inhabits the coniferous woods at an altitude of from about 8,000 feet up to timber line, and I noticed that it preferred localities where the trees had been deadened by fire. The only places, in Nevada, where I met with this bird, were the pine woods of the East Humboldt and Ruby Mountains." Concerning its occurrence in California, Dr. Cooper says: "It seems to be resident in most parts of the State where it is found, but not occurring south of Monterey, where Dr. Gambel found young in July. I found them rather common in the Coast Range toward Santa Cruz, where they had nests in May, but I could not examine any of these, their location being generally on a high inaccessible branch. I also found this bird at Lake Tahoe in September. It is rather silent, keeping mostly on tops of the trees, and catching passing insects."† Mr. Ridgway also found it breeding in California, "on the eastern slope of the Sierra Nevada."‡ In Oregon and Washington Territory it is, according to Dr. Cooper, "a much more abundant bird near the Columbia River and throughout the northern Rocky Mountains. There they migrate, remaining at the Lower Columbia from May to October."§ Dr. Brewer writes: "In Washington Territory this bird appears to be somewhat more common than in other portions of the United States. Dr. Suckly obtained a specimen at Fort Steila-coom, July 10th, 1856. It was not very abundant about Puget Sound, and showed a preference for shady thickets and dense foliage [contrary to its usual habit], where it was not easily shot." "A single specimen," continues Dr. Brewer, "was taken, Aug. 29th, 1840, at Nenortalik, Greenland [by Reinhardt], and sent to Copenhagen."§ Hence the distribution of this beautiful and interesting Flycatcher affords an excellent illustration of the manner in which some species that are confined, during the breeding season, to the Canadian and Alleghanian faunæ in the Eastern Province, are found, during the same period, in the far West, extending from the Saskatchewan, in British America, almost, if not quite, to Mexico.

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\* Bull. Essex. Inst., vol. vii, No. 1, pp. 21, 38. Jan., 1875.

† Ornithology of California, vol. i, p. 324. 1870.

‡ Bull. Essex. Inst., vol. vi, No. 10, p. 174. Oct., 1874.

§ Baird, Brewer and Ridgway, *Birds N. Am.*, vol. ii, p. 356. 1874.

124. *Contopus virens* (Linné) Cabanis. Wood Pewee.

A common summer resident, generally placing its beautiful lichen-covered nest astride the horizontal branch of some tall birch, or maple, in deep forests, but sometimes choosing an orchard or garden, in close proximity to occupied buildings. Arrives before the middle of May (May 10, 1876, Osborne), remaining through September. It is one of the few birds that may be found alike, during the breeding season, in the heart of the city, near the farm house, and in the darkest swamps and most secluded forests, far from the habitations of man. Its mournful note may sometimes be heard at all hours of the night.

125. *Empidonax Acadicus* (Gmelin) Baird. Acadian Flycatcher; Small Green-crested Flycatcher.

A rare summer visitant from the Middle States; may breed in the Connecticut Valley.

It affords me great pleasure to be able, through the kindness of Mr. Erwin I. Shores, to replace this species among the birds of New England. As is well known, it was formerly included in all New England lists, but, as shown by Dr. Coues, Mr. H. W. Henshaw, and others, the records were founded on erroneous identifications—the bird having been mistaken for *E. minimus* or *Traillii*, generally the former. In a letter to Dr. Coues, Dr. Brewer says "I do not think the bird occurs in New England, even in the Connecticut Valley,"\* and Mr. William Brewster, of Cambridge, the highest authority on the Birds of New England, has expressed similar views. Hence it was with a peculiar sense of gratification that I received, a few days since, an unmistakable example of this species, from Mr. Shores, who states that he shot it "in Suffield, Conn., June 24th, 1874, in a piece of woods known as Beech Swamp." For the benefit of those who might not feel disposed to accept my identification in so important a matter, and to avoid all possibility of mistake, I at once sent the bird to my friend Mr. Robert Ridgway, of the Smithsonian Institution, and he pronounces it to be a "typical *E. Acadicus*."

126. *Empidonax Traillii* (Audubon) Baird. Traill's Flycatcher.

A common summer resident, arriving early in May (May 6, 1877). Frequents swampy lowlands, where it breeds.

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\* Birds of the Northwest, p. 251. 1874.

127. *Empidonax minimus* Baird. Least Flycatcher.

An abundant summer resident, arriving early in May (May 5, 1877), and remaining till late in September. Breeds abundantly in gardens throughout the city.

128. *Empidonax flaviventris* Baird. Yellow-bellied Flycatcher.

Not uncommon during migrations; arrives about the middle of May (May 20, 1876), remaining till the last of the month, and Mr. Grinnell tells me he has seen it in early June. Have taken it in fall, about the middle of September (Sept. 17, 1875). Not known to breed.

Family, CAPRIMULGIDÆ.

129. *Antrostomus vociferus* (Wilson) Bonaparte. Whippoorwill.

A common summer resident. Arrives early in May (May 2, 1877, Osborne). Nocturnal, spending the day on the ground beneath some tree, or among thick bushes. When disturbed, its flight is short and irregular, and it may easily be shot. The Stadtmüller Brothers have an unusually pale set of eggs taken on Mill Rock (near New Haven) May 30th, 1875. "They were not placed by the side of a rock or log, as Samuels says."\*

130. *Chordeiles Virginianus* (Brisson) Bonaparte. Night-hawk;  
Bull-bat.

A common summer resident, arriving early in May (May 11, 1875, Sage). Mr. W. W. Coe has taken its eggs as late as June 23d (1872). By no means strictly nocturnal like the last, but may be seen, especially in autumn, flying about high in the air and constantly uttering its peculiar cry, at any hour of the day, though generally preferring the twilight. Commonly roosts on old logs or horizontal limbs (sometimes quite high up) on which they lie longitudinally.

131. *Chætura pelagica* (Linné) Baird. Chimney Swift.

An abundant summer resident, arriving in April or May (April 14, 1876, Osborne; April 30, 1877, May 5, 1874, Portland, Sage; May 8, 1874), and remaining till late in September (Sept. 27, Osborne); breeds abundantly in old chimneys. Before the days of

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\* MS. notes of the Stadtmüller Brothers.



brick chimneys, and to some extent since, these birds used to congregate in multitudes about certain large hollow trees, where they bred regularly, and, according to some, spent the winter also. Williams, in his "Natural and Civil History of Vermont," published in 1794, relates the following concerning three "Swallow trees" which came under his observation. "The species called the house or Chimney Swallow, has been found during the winter, in hollow trees. At *Middlebury* in this State, there was a large hollow elm, called by the people in the vicinity the Swallow tree. From a man who, for several years, lived within twenty rods of it, I procured this information: He always thought the Swallows tarried in the tree through the winter, and avoided cutting it down, on that account. About the first of May, the Swallows came out of it, in large numbers, about the middle of the day; and soon returned. As the weather grew warmer, they came out in the morning with a loud noise, or roar, and were soon dispersed; about half an hour before sun down, they returned in millions, circulating two or three times round the tree, and then descending like a stream, into a hole about sixty feet from the ground. It was customary for persons in the vicinity, to visit this tree, to observe the motions of these birds. And when any persons disturbed their operations, by striking violently against the tree, with their axes, the Swallows would rush out in millions, and with a great noise. In November, 1791, the top of this tree was blown down, twenty feet below where the Swallows entered. There has been no appearance of the Swallows since. Upon cutting down the remainder, an immense quantity of excrements, quills, and feathers, were found; but no appearance or relicks of any nests. Another of these swallow trees was at *Bridport*. The man who lived the nearest to it, gave this account: The Swallows were first observed to come out of the tree, in the spring; about the time that the leaves first began to appear on the trees. From that season, they come out in the morning, about half an hour after sunrise. They rushed out like a stream, as big as the hole in the tree would admit, and ascended in a perpendicular line, until they were about the height of the adjacent trees; then assumed a circular motion, performing their revolutions two or three times, but always in a larger circle, and then dispersed in every direction. A little before sundown, they returned in immense numbers, forming several circular motions, and then descended like a stream into the hole, from whence they came out in the morning. About the middle of September, they were seen entering the tree, for the last time." "Neither of these accounts are attended

with the highest degree of evidence, which the subject may admit of: but I am led to believe from them, that the House Swallow, in this part of America, generally resides during the winter, in the hollow of trees.”\*

The tree above described, from Middlebury, Vermont, finally blew down, and, more than half a century (in 1852) after Williams wrote the account above given of it, its *remains* were visited by his successor, in the historical line, Zadock Thompson, and were found scarcely less interesting than the tree itself when inhabited by thousands of Swifts. Thompson gave this account of its condition and contents in 1852: “The tree had rotted away, leaving little besides the cylindrical mass, which had filled its hollow. The length of this mass was about seven feet, and its diameter fifteen inches. Of the materials which composed it, about one-half consisted of the feathers of the Chimney Swallow, being, for the most part, wing and tail feathers. The other half was made up of exuvia of insects, mostly fragments and eggs of the large wood-ant, and a brown substance probably derived from the decayed wood of the interior of the tree. This discovery at Middlebury, though interesting, would not have been regarded as very remarkable, if the materials which filled the hollow of the tree, had been promiscuously and disorderly mingled together. Such a jumbled mass would be what we should expect to find in a hollow tree which had been, for centuries, perhaps, the roosting place of myriads of Swallows. But this is not the case. In their general arrangement, the larger feathers have nearly all their quills pointing outward, while their plumes, or ends on which their webs are arranged, point inward. . . . But this is not the most remarkable circumstance connected with the subject. In various parts of the mass, are found, in some cases, all the primary feathers of the wing; in others, all the feathers of the tail, lying together in contact, and in precisely the same order and position, in which they are found in the living Swallow. In a lump of the materials, measuring not more than seven inches by five, and less than three inches thick, five wings and two tails were plainly seen, with their feathers arranged as above mentioned, and in one of the wings, all the secondary quills were also arranged in their true position with regard to the primaries. Now, we cannot conceive it possible that these feathers could be shed by living birds, and be thus deposited. We may

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\* The Natural and Civil History of Vermont. By Samuel Williams, pp. 116-18. 1794.

suppose that the birds died there, and that their flesh had been removed by decay, or by insects, without deranging the feathers. But in that case what has become of the skeletons? I do not learn that a bone, beak, or a claw, has been found in any part of the whole mass. What then has become of these? They could hardly have been removed by violent means, without disturbing the feathers. But, if done quietly, what did it? What insect would devour the bones, and beak, and claws, and not meddle with the quills? Or would the formic, or any other acid, which might be generated within the mass, dissolve the former without affecting the latter?\*"\*

### Family, TROCHILIDÆ.

#### 132. *Trochilus colubris* Linné. Ruby-throated Hummingbird.

A common summer resident. Arrives early in May (May 5, 1877), remaining till the middle of October (Oct. 5, 1876; Oct. 16, 1874). They usually breed early in June, but Dr. F. W. Hall informs me that a friend of his found a nest completed, and containing two eggs, as early as May 27th (1877).

Thomas Morton, in 1632, expressed his astonishment at the dimensions and habits of this bird, in the following words: "There is a curious bird to see to, called a hunning bird, no bigger than a great Beetle; that out of question lives upon the Bee, which he eateth and catcheth amongst Flowers. For it is his custome to frequent these places. Flowers hee cannot feed upon by reason of his sharp bill, which is like the poynt of a Spanish needle, but shorte. His fethers have a glasse like silke, and as hee stirres, they show to be of a chaingable coloure: and has bin, and is admired for shape, coloure, and size."† And two years later, William Wood, in his "New England's Prospect" informs us that "The Humbird is one of the wonders of the Countrey, being no bigger than a Hornet, yet hath all the demensions of a Bird, as bill, and wings, with quills, spider-like legges, small clawes: For colour she is as glorious as the Raiue-bow, as she flies, she makes a little humming noise like a Humble-bee: wherefore shee is called the Humbird."‡

"The Humberd for some Queene's rich Cage more fit,  
Than in the vacant Wildernesse to sit."‡

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\* Zadock Thompson, *Appendix to the History of Vermont*, p. 26, 1853.

† Force's *Historical Tracts*, vol. ii, Tract 5, p. 50.

‡ *New England's Prospect*, by William Wood. p. 31, 1634.

\*  
Family, *ALCEDINIDÆ*.133. *Ceryle alcyon* (Linné) Boie. Belted Kingfisher.

A common summer resident about water courses and along the coast. Arrives during the latter part of March (Mar. 29, 1877), remaining into November (Nov. 13, 1875). A few sometimes winter. One was seen near Hartford, Feb. 13, 1874, by Mr. K. C. Humphrey.\* Mr. Fred. S. Smith, of this city, informs me that he once found the eggs of this species placed on a bed of fish bones, about six feet from the entrance to the hole. This was near Lake Whitney, Conn. In this latitude their eggs are generally deposited during the latter part of May. Josselyn, in enumerating the birds of New England, in 1675, says there are "*Kings fishers*, which breed in the spring in holes in the Sea-bank, being unapt to propagate in Summer, by reason of the driness of their bodies, which becomes more moist when their pores are closed by cold."†

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Family, *CUCULIDÆ*.134. *Coccyzus erythrophthalmus* (Wilson) Bonaparte. Black-billed Cuckoo.

A common summer resident, arriving about the middle of May (May 15, 1876), and remaining till the latter part of September (Sept. 28, 1875).

135. *Coccyzus Americanus* (Linné) Bonaparte. Yellow-billed Cuckoo.

A common summer resident. Arrives early in May (May 7, 1876), remaining into October (Oct. 11, 1873, shot, Hall). Both Mr. Coe and myself have found, on the same day, and in the same Cuckoo's nest, fresh eggs and young birds.

Family, *PICIDÆ*.136. *Hylotomus pileatus* (Linné) Baird. Pileated Woodpecker.

A rare winter visitant; it was once common throughout the State, but is now almost exterminated and driven into the less civilized districts. Linsley gave it from Stratford and New Haven. Mr. W. W. Coe tells me that a specimen was killed near Portland, Conn., in

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\* MS. notes of John H. Sage, Esq.

† Voyages to New England, p. 101, 1675.

November, 1876; and "Mr. Wm. King took a specimen, several years ago, at Suffield, Conn."\* No longer ago than 1839, Peabody gave it as resident in Massachusetts, where it was "not uncommon in the woodlands."†

137. *Picus villosus* Linné. Hairy Woodpecker.

Resident, but not common. Have taken four specimens and seen several others in the immediate vicinity of New Haven. Found chiefly in winter. Mr. Coe tells me that it is quite common about Portland, Conn.

138. *Picus pubescens* Linné. Downy Woodpecker.

A common resident; found everywhere except in open fields devoid of stumps and fences.

139. *Picoides arcticus* (Swainson) Gray. Black-backed Three-toed Woodpecker.

A rare winter visitor from the North. In the Museum at Middletown is a specimen, from the Shurtleff Collection, taken at Simsbury, Conn., in 1860. Dr. Wood has also taken it at East Windsor Hill, Conn.

140. *Sphyrapicus varius* (Linné) Baird. Yellow-bellied Woodpecker.

Rare about New Haven. Have seen but four individuals (Sept. 28, and Oct. 2, 1875, and March 30, and May 3, 1876). Mr. J. N. Clark finds it to be "abundant in fall" at Saybrook.‡ Linsley gave it from New London, Conn. It is rare about Portland, Conn., as I am informed by Messrs. Coe and Sage. Mr. Thos. Osborne tells me that they were quite common about New Haven last fall (1876) and that he secured four specimens. Mr. Grinnell says that it is not uncommon about Milford, Conn., in fall; and Mr. J. N. Clark, of Saybrook, writes me that he has observed it to be "very common both in spring and fall," but that he "never saw it after April till autumn."

Though most Woodpeckers are residents where they are found at

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\* MS. notes of Erwin I. Shores.

† Peabody's Report on the Ornithology of Mass., p. 334. 1839.

‡ Am. Nat., vol. vii, No. 11, p. 693. Nov., 1873.

all, in any numbers, this is truly, though not strictly, a migrant.\* Dr. Wm. O. Ayres writes me: "At New Canaan, Conn., I used to find them each autumn, though never very numerous; I never saw them in the spring.

141. *Centurus Carolinus* (Linné) Swainson. Red-bellied Woodpecker.

A rare accidental visitor from the South. Linsley saw one "ascending an apple tree, on the 16th of October, 1842."† Dr. Crary says he has killed it near Hartford, Conn.; and Mr. Erwin I. Shores writes me that he "took a female, July 30th, 1874," at Suffield, Conn. Giraud gave it as breeding regularly on Long Island, though not very common.‡

142. *Melanerpes erythrocephalus* (Linné) Swainson. Red-headed Woodpecker.

A rare summer resident; breeds at Saybrook, sometimes remaining all winter.§ Linsley gave it from Stratford, and Dr. J. D. Whelpley informed him that it was, "rare at New Haven"† thirty-five years ago, and, so far as I am aware, its numbers have not increased since. In fact, as Dr. Coues has remarked: "Comparisons of the older with more recent local authorities indicate that the species is now much less numerous than formerly."|| Dr. F. W. Hall took one at West Haven in December, 1872, and has seen several other specimens in this vicinity. W. W. Coe and J. H. Sage have each taken it about Portland, Conn., but find it rarely. Dr. Wood, of East Windsor Hill, tells me that they were really abundant, in that vicinity, thirty-five years ago, being more numerous than the Flicker (*Colaptes auratus*). Four years later a large flock was seen, and since then they have been one of our rare birds. A few, however, still breed pretty regularly in the vicinity of East Windsor, Conn. Mr. J. N. Clark informs me that, during the latter part of September, 1872, they suddenly became abundant in a grove of oaks near Saybrook, Conn. The adult birds were mostly killed off by boys from the neighborhood, while the young-of-the-year, lacking the brilliant and

\* For a valuable contribution to the biography of this beautiful Woodpecker, see an article by William Brewster, in Bull. Nutt. Ornith. Club, vol. i, No. 3, pp. 63-70. Sept., 1876.

† Am. Jour. Sci. and Arts, vol. xlv, No. 2, p. 263. April, 1843.

‡ Birds of Long Island, p. 179. 1844.

§ Am. Nat., vol. vii, No. 11, p. 693. Nov., 1873.

|| A List of the Birds of New England. [From Proc. Essex Inst., vol. v, p. 15.] 1868.

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much prized red heads, were spared and remained through the winter—some even breeding there the next summer (1873). Mr. J. H. Sage killed one at Hartford, Dec. 31st, of the same winter (1872). Their food consisted chiefly of acorns. In this connection I will state that in northern New York (Lewis Co.), where they are usually one of our commonest Woodpeckers, they subsist almost exclusively on beech-nuts, of which they evidently are extremely fond, eating them, apparently with equal relish, whether green or fully matured. It is truly a beautiful sight to watch these magnificent birds, together with their equally abundant cousins, the Yellow-bellied Woodpeckers (*Sphyrapicus varius*), creeping about, after the manner of the Warblers, among the small branches and twigs, which bend low with their weight, while picking and husking the tender nuts—the bright crimson of the head, neck and breast, the glossy blue-black back, and creamy-white belly, together with the scarcely less striking colors of their yellow-bellied companions, contrast handsomely with the deep green foliage.

143. *Colaptes auratus* (Linné) Swainson. Golden-winged Woodpecker; Yellow-hammer; High-holder; Flicker; Yaffle.

Resident; common from early April till November. A few generally winter. It breeds in holes in old stubs and trees. The migrants arrive during the latter part of March (March 28), remaining till the middle or latter part of November (Nov. 14 and 28). My friend, Mr. A. J. Dayan, saw one, near New Haven, on the 26th of January, 1877. Mr. Geo. Bird Grinnell tells me that he has taken it, near Milford, Conn., in December (Dec. 25, 1876), January (Jan. 1, 1877), and February (Feb. 27, 1875). Mr. W. W. Coe writes me that they also spend the winter in the vicinity of Portland, Conn.

Kalm states, in his *Travels*, that "this species is destructive to maize-fields and orchards, for it pecks through the ears of maize, and eats apples. . . . Some years ago there was a premium of two pence per head, paid from the public funds, in order to extirpate this pernicious bird."\*

#### Family, STRIGIDÆ.

144. *Strix flammea*, var. *Americana* (Audubon) Schl. Barn Owl.

A rare accidental visitor from the South. Taken by Linsley at Stratford, Conn.† Prof. J. A. Allen states that Dr. Wood "has a

\* Peter Kalm's *Travels into North America*, vol. ii, pp. 86-7. 1771.

† Catal. Birds Conn., p. 253. 1843.

specimen in his cabinet that was shot 'at Sachem's Head, Connecticut, Oct. 28th, 1868.'"<sup>\*</sup> Massachusetts also lays claim to two specimens: the first "was killed near Springfield, Mass., about the last of May," 1868,<sup>†</sup> and the other "was shot near Lynn, in the same State, in 1863."<sup>‡</sup>

Since writing the above I have seen, in the cabinet of Capt. O. N. Brooks, at Faulkner's Island, Conn., a mounted specimen of this species which was killed at Madison, Conn., some years ago; and Dr. Wm. O. Ayres, now of Easthampton, Long Island, writes me that he found one at Hartford, Conn., about the year 1841. Hence at least four have been killed in this State.

#### 145. *Bubo Virginianus* (Gmelin) Bonaparte. Great Horned Owl.

Resident; not rare. Breeds in suitable localities throughout the State. It feeds on the larger game (hares, grouse, and the like), not forgetting the poultry yard, and seems particularly fond of turkeys, of which it seldom touches more than the head, if there are a plenty about. Indeed I have known one to kill and decapitate three turkeys and several hens in a single night, leaving the bodies uninjured and fit for the table. Hence, if not so prone to select valuable fowls the loss would not be great. Their tenacity to life is something remarkable. A number of years ago I kept one in confinement for six or eight months, during which time I was twice attacked by him and bear the marks of his talons to this day. On both of these occasions I kicked and pounded him with sticks till he was, as I supposed, dead, but always on returning to skin the bird I found him sitting up on his perch, blinking, snapping his bill, and making faces at me as usual. Dr. Wood writes that a gentleman, while viewing one of this species in his collection, said: "I suppose that is the kind of bird that once scared me almost to death. While riding on horseback through a tract of large woods in New York State, one night, with a white beaver on my head, something, without the least noise or warning, struck my head with such force that it took my hat, and I supposed for a time the top of my head off. I thought the devil was after me, and the way that old horse went for the next three miles would have astonished John Gilpin. It seemed to me my heart beat

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<sup>\*</sup> Notes on some of the Rarer Birds of Massachusetts, p. 17. 1869. I have lately seen this specimen.

<sup>†</sup> Proceed. Essex Institute, vol. v, p. 312.

<sup>‡</sup> Coues' Birds of the Northwest, p. 300. 1874.



louder than an ordinary church bell, and I had to swallow fast to keep it from coming into my throat and choking me.”\*

My friend, Mr. W. W. Coe, of Portland, Conn., has had such remarkable success in finding the nests, and securing the eggs, of this species, that I was induced to trouble him for an account of some of his exploits in that direction, and he has been kind enough to favor me with the following: “In 1868, a farmer’s boy told me that a pair of Great Horned Owls and their two young had taken up their abode in a piece of woods near his place, and that a pair had lived there for several years. He had often seen them when at work in the woods in winter, and observed them one morning on the lower limbs of a large hemlock. One sat on a branch directly above the other and had a rabbit in its claws, upon which they both seemed to be feeding. He watched them for sometime and then frightened them off. The bird with the rabbit carried it with him a short distance, but finally dropped it. The boy offered to shoot one of the Owls for me, but I told him not to do it, for I wanted to get the eggs, if possible, the next year.

“On the first of May, 1869, we went to look for the nest and found it in a large chestnut tree. It contained two young Owls almost large enough to fly. I brought them both home, stuffed one, and kept the other alive sometime, when it got killed while I was away. During the latter part of March, 1870, we went again and found the Owls occupying the same nest. One old bird was on, and I thought myself sure of the eggs this time, but on ascending to the nest found two young Owls covered with down. They were, I should think, about two weeks old, so we left them for seed and determined to be in time next season, but sickness and extra work forced me to neglect it. In the following year (1872) we started out on the 2d of March and visited the old nest, but for some reason it had been abandoned. We then visited another piece of woods near by and soon found a very large nest in a chestnut tree, but it showed no sign of life. While deliberating whether it was best to climb it or not, I gave the tree several hard raps with a club, when off went the old bird with a *hoo, hoo, hoo*. My companion climbed the tree and found two eggs. I thought they might lay again, since it was so early, and accordingly, on the 12th of April, visited the same nest, and, on getting near, a bird jumped up from it which I at first took to be the Owl, but as it started off I saw it was a Red-tailed Hawk, which we found had

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\* *Hartford Times*, chap. xvii, July 20, 1861.

taken possession and layed two eggs. We then went to the old Owl's nest, where we had found young in 1869 and 1870, and found the old bird on. This nest now contained two eggs in which the young were well advanced—so the old birds must have laid again soon after the first nest was robbed.

“About the first of March, 1873, we again visited the same place but could not find the birds, though I noticed one of their feathers, and, since snow had fallen a day or two before, I know they could not be far off. Finally, on the 13th of March, I found them occupying a nest about two miles from the old place. It was the old nest of a Red-tailed Hawk from which I took three eggs April 29th, 1872. The nest now contained one young Owl, apparently about five or six days old, and one rotten egg. I think the egg had been frozen, for it was badly cracked. I am, of course, unable to say whether or no all the eggs above mentioned were deposited by the same pair of Owls, since three or four old birds have been killed in this vicinity. However, I am quite sure that they all belonged to the same family. I also took their nests in 1874 (Feb. 28), 1875 (took young in May), 1876 (Feb. 22), and 1877 (took eggs twice, Feb. 19 and Mar. 23). During the whole time I have known of them they have not built a new nest, but have either occupied the same one for at least three years, or taken some vacant Hawk's nest.

“To sum up: my experience with Great Horned Owls has been that they lay in old nests of Red-tailed Hawks, in hollow trees, and occasionally in ledges of rocks. I never knew them to build a nest, or to lay more than two eggs, and I have known of many nests not mentioned above.”

**146. *Scops asio* (Linné) Bonaparte.      Mottled Owl; Screech Owl.**

A common resident throughout the State. It lays five eggs, in a hollow tree, about the last of April. This is, I think, the most nocturnal of our Owls. At least it can generally be approached in broad day-light more easily than the other species, and seems to be dazzled by the light. It sometimes catches fish through a hole in the ice, like the Snowy Owl.\*

**147. *Otus vulgaris*, var. *Wilsonianus* (Lesson) Allen.      Long-eared Owl.**

A common resident. Its large nest is commonly placed on some thick tree—generally a pine—but sometimes in low bushes. It is

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\* Bull. Nutt. Ornithol. Club, vol. ii, No. 3, p. 80. July, 1877.

said to take possession of the deserted nests of Crows and Hawks. "Mr. J. S. Brandigee, of Berlin, Conn., found a nest, early in April, in a hemlock tree, situated in a thick dark evergreen woods. The nest was flat, made of coarse sticks, and contained four fresh eggs."\* Have taken it, in company with the following species, in clumps of low bushes near the coast.

148. *Brachyotus palustris* (Bechst.) Gould. Short-eared Owl.

Resident about the salt marshes near the coast; also found throughout the State. Nests on the ground. Not uncommon. In the year 1856, on the island of Grand Menan, "A nest of this bird was found by Mr. Cabot in the midst of a dry, peaty bog. It was built on the ground, in a very slovenly manner, of small sticks and a few feathers, and presented hardly any excavation."†

149. *Syrnium cinereum* (Gmelin) Audubon. Great Gray Owl.

A rare straggler from the north. Linsley captured a specimen at Stratford, Conn., Jan. 6, 1843.‡

During the winter of 1852 a large Great Gray Owl was killed near Boston, Mass., after creating some little excitement among the inhabitants: "A light snow fell on Sunday evening, March 21st, and the next morning mysterious footprints were discovered in the vicinity of Nahant street and Long Beach. They were of a shape that excited much curiosity, and no one was able to determine what sort of a creature had made them. But on Monday evening Mr. John Barry shot a very large gray owl, on the marsh, near the foot of Pleasant street, and it was concluded that the wonderful tracks were made by him: He measured more than five feet from tip to tip of the wings."§

150. *Syrnium nebulosum* (Forster) Boie. Barred Owl.

A common resident throughout the State. Mr. J. N. Clark, of Saybrook, Conn., tells me that he once found it breeding, in a hollow tree, within twenty-five rods of the nest of a pair of Great Horned Owls.

\* Baird, Brewer & Ridgway, vol. iii, p. 22, 1874.

† A List of Birds observed at Grand Menan and at Yarmouth, N. S., June 16 to July 8, 1856. Proceed. Boston Soc. Nat. Hist., vol. vi, p. 115. March, 1857.

‡ Am. Jour. Sci. and Arts, vol. xlv, No. 2, p. 253. April, 1843.

§ History of Lynn, Mass., pp. 432-3, 1865.

Dr. Wm. Wood, of East Windsor Hill, Conn., relates the following amusing anecdote, which serves well to illustrate "the nature of the beast" under certain conditions, and at the same time affords us an excellent example of conjugal affection and innate wisdom in our own species: "A gentleman who fancied himself a taxidermist because, forsooth, he had seen a single specimen stuffed, determined to allow that talent no longer to be buried, but bring it to light by practically demonstrating to the world in general, and mankind in particular, the way by which the feathered species can forever look 'as natural as life and a little more so.' Having obtained a specimen of the Barred Owl that was only slightly winged, he let it loose in the cellar till a leisure day. The bird, with only the tip of the wing injured, and having free use of its limbs and feet, could visit any part of her prison, and finding herself sole mistress, was not long in appropriating anything and everything that would promote her own comfort and ease. The potato and apple bins, as well as the soap and pork barrels were indiscriminately and alike used for places of rest and repose. The day arrived when this nuisance could no longer be tolerated. Approaching, with hand extended, to seize the Owl, my friend received the benefit of her claws in and around his fingers. Grasping the bird's leg to disengage it from its gripe, the other claw was instantly brought in requisition and seized the other hand. Both hands being now securely held by the bird, no wonder that our hero called out lustily for help when he saw the Owl expanding herself almost indefinitely, and snapping her bill in anticipation of the dainty repast which, according to appearance, she was about to swallow! The terrified scream alarmed the whole household, and the rush down the cellar stairs reminds one very forcibly of the second and fourth illustrations in Bachelor Butterfly, on page 14th, where he jumped overboard, and, in order to save the life of the Naturalist, was followed by his omnipresent Dorothy and the whole crew. His better half becoming alarmed for the safety of her beloved, seized the enraged bird by the head and pulled with all the force that conjugal fidelity or nervous excitement could arouse. The more she pulled the deeper were the talons of the Owl inserted, as was evidenced by the musical entertainment given by our friend, which comprised a scale of at least two octaves, with trills and variations that would have astonished an Italian prima donna! What more could be done? The adage that 'necessity is the mother of invention' proved true in this case, for the imminent danger, to say nothing of the excruciating pain, roused our hero to the importance of trying what

virtue there was in his incisors. Being blest with a good set he with much difficulty succeeded in biting off all the claws of the Owl, and relieving himself from his perilous position, probably a wiser man for his first lesson in Ornithology.”\*

Surely Thomas Morton, Esq., could not have been familiar with the love calls of this species, or he would never have written: “There are Owles of divers kindes: but I did never heare any of them whop as ours doe.”†

#### 151. *Nyctea Scandiaca* (Linné) Newton.      Snowy Owl.

This magnificent bird seems to be a pretty regular winter visitant along our coast. Linsley had secured five specimens from Stratford, Conn., and Dr. Whelpley had observed it at New Haven, prior to the year 1843.‡ Two specimens came to my notice during the winter of 1875-6 (the first on Nov. 10), and no less than a dozen specimens were killed in the immediate vicinity of New Haven in October (Oct. 17, Osborne), and November last (1876). They unquestionably belonged to the immense flock of these Owls that passed through eastern Massachusetts about the same time. Over *two hundred* specimens were shot about Boston in October and November. For a detailed account of this wonderful and really perplexing migration, consult an article by Ruthven Deane, Esq., in the Bulletin of the Nuttall Ornithological Club, No. 1, vol. ii, p. 9, for January, 1877. Dr. Wm. Wood, of East Windsor Hill, Conn., writes that they were unusually abundant here during the winter of 1858-9, when fifteen or twenty were shot in Hartford County. He further observes that “it hunts either by day, or in the twilight, occasionally pursuing game on the wing and securing it after the manner of the true falcons, but generally devouring it on the spot like the Marsh Hawk. When annoyed and teased by Crows it will now and then seek shelter in a hollow tree. Some years since I was pursuing one of these birds, in our meadows, that was followed and tormented by a great number of Crows. It finally alighted on an apple tree about a hundred rods distant, and in a few moments the whole tree was black with his tormenters, and still they came from all directions, attracted by the noise and confusion of those diving at the Owl. Soon they began to

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\* Hartford Times, chap. xi, August 17, 1861.

† New English Canaan, p. 49. (Reprinted in Force's Historical Tracts, Tract 5, vol. ii.)

‡ Am. Jour. Sci. and Arts, No. 2, vol. xliv, p. 253, 1843.

leave, and before my arrival all was quiet. This was a mystery to me, for I had not seen the Owl fly, and if he had, the crows would certainly have given the alarm and followed him, yet no Owl was in sight. Having passed the tree some fifteen or twenty rods I heard a noise, and turning about saw the Owl coming out of a hollow apple-tree stump close by the tree. This was rather provoking, for I had been, just a moment before, near enough to the stump to have touched it with my gun.”\*

About the middle of March, 1863, “four large Arctic Owls were shot during one week, at Nahant, and on the beaches” about Boston.†

152. *Surnia ulula*, var. *Hudsonia* (Gmelin) Coues. Hawk Owl.

A rare winter visitor from the North. To Dr. F. W. Hall belongs the honor of adding this species to the birds of our State. In Nov. 1869, he saw the bird in an elm tree in an open field. Not having a gun with him he returned for it and secured a fine specimen of the Hawk Owl. It was mounted by the Rev. C. M. Jones, and is now in the cabinet of Dr. Hall. In the vicinity of Hudson’s Bay, during the winter season, the white Ptarmigan (*Lagopus albus*) constitutes its chief article of diet; and it is said to follow the hunter, pouncing upon his game before he has time to reach it. As early as 1833 the Hawk Owl was recorded, by Ebenezer Emmons, M.D., as a rare “autumn” visitant in Massachusetts.‡ It has been shot as far South as Haddington, near Philadelphia.§

153. *Nyctale Tengmalmi*, var. *Richardsoni* (Bonaparte) Ridgway. Richardson Owl.

An extremely rare accidental winter visitor from the North. Dr. Wm. Wood has a fine specimen of this boreal Owl in his cabinet. It was captured some twenty years ago, in mid-winter, near East Windsor, Conn. The doctor gives the following account of the manner in which he came in possession of this specimen, in one of his interesting articles published in the “Hartford Times,” Aug. 24th, 1861: “Visiting a patient some three miles from my office, I was

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\* Hartford Times, chap. xvi, July 6, 1861.

† History of Lynn, Mass., by Alonzo Lewis and James R. Newhall, p. 473, 1865.

‡ Report on the Geology, Mineralogy, Botany, and Zoology of Massachusetts. By Edward Hitchcock, Amherst. p. 546. 1833.

§ Birds of East Pennsylvania and New Jersey. By William P. Turnbull, M.D., p. 41. 1869.

informed that word had been left for me to call at a house near by. On driving over and meeting the occupant at the gate, I inquired who was sick? After giving me an evasive answer I was invited into the house. Being well acquainted with the gentleman, and knowing that he had quite a taste for natural history, I began to suspect that it was not professional advice that was wanting. Leaving the room for a few minutes, he returned with an Owl. This bird, he informed me, sat upon the verandah early the previous morning, and approaching cautiously, he captured it without its making the least resistance or effort to escape, and put it into a cage. The next morning, from some unknown cause, the bird was found dead, and 'thinking it might be something a little different from any in my collection,' he saved it for me. No one but a naturalist can imagine the satisfaction it afforded me when I beheld Richardson's Owl; and I assure you that I would not only have gone three miles, but ten times three to obtain it." Several specimens have been taken in Massachusetts.\*

154. *Nyctale Acadica* (Gmelin) Bonaparte. Acadian Owl; Saw-whet Owl.

Resident, though rather rare, or at least not often seen, for, owing to its diminutive size and nocturnal habits, it might be quite common and yet escape notice. Linsley never saw "but two individuals," one of which "was found lying upon his back in a barn-yard in a cold morning in March, 1841, though still living." A specimen was taken at East Haven, Conn., Nov. 26th, 1874, by Dr. F. W. Hall.

Mr. Coe and Mr. Sage have each fine examples of this species in their cabinets, and the former gentleman showed me a set of five eggs found in a hole in a tree near Portland, Conn. Dr. Wood, of East Windsor Hill, has several specimens taken in that vicinity, and I have lately seen quite a number, killed about New Haven, and throughout the State. It feeds on small birds, mice, grasshoppers, beetles, etc. "For rearing its young the Saw-whet takes possession of the old nest of a crow, or some other large bird, or of a hollow cavity of an old tree."†

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\* J. A. Allen's Notes on some of the Rarer Birds of Mass., pp. 47-8. 1869.

† Zadock Thompson's History of Vermont, pp. 66-7. 1842.

## Family, FALCONIDÆ.

155. *Circus cyaneus*, var. *Hudsonius* (Linné) Schl. Marsh Hawk;  
Harrier; "Mouse Hawk."

A tolerably common summer resident, especially about salt marshes, where it breeds, placing its nest on the ground. Arrives in March or April (April 9, 1876, Osborne), remaining into November (Nov. 6).

I take the following interesting account of the audacity sometimes displayed by this bird, from one of Dr. Wood's articles in the *Hartford Times*: "If once introduced to your young poultry a faithful supervision will be exercised over them to see that none *are left* to suffer from want of attention or hunger. I know of an instance where the old bird returned daily, and about the same hour, until all were taken. Coming one day when the owner was there, the Hawk evidently intended to convince him that he was sole proprietor of that brood. The chickens having fled into the coop, he made himself quite at home by alighting on the shed near by and waiting for them to appear. The farmer caught up a stick and threw it at him, which so enraged the bird that it flew about his head, diving at him and squealing at a most furious rate, when he returned again to the shed, scolding vehemently. The farmer remarked that 'he was the sauciest little thing he ever saw.' In capturing mice partly concealed they sometimes 'wake up the wrong passenger' and get captured. An instance of this occurred in East Hartford. A Mouse Hawk was observed sailing over some tall grass, evidently intent on game. Poising himself for a moment by the slow, easy flappings of his wings, he suddenly dove, and soon appeared, ascending slowly and with difficulty. The very singular movements of the Hawk attracted the notice of several persons who were talking together, and they watched every motion with interest. He gradually rose higher and higher, till his strength began to fail, when he began to descend obliquely for a little way, then headlong to the ground. On arriving at the place they found that the Hawk had seized a weasel, that had killed its assailant by eating into the sides of the bird, where he was still at work!"

"Some years since, a student in the seminary came running up to me in a great hurry, almost out of breath, puffing like a locomotive, and exclaiming, 'Doc—doc—doctor,—can—you—shoot—flying?' I replied that sometimes I did such things. "Well, I wish you would go out East and shoot a Hawk that has chased me for half a



mile, diving so close to my head that I expected every moment he would have hold of me.' Taking my gun, we walked towards the swamp, when he informed me that 'he came out there to practice elocution, so as not to disturb any one, and before he had finished the vowel sounds the Hawk came at him.' On arriving near the place I requested him to commence his vocal exercises again, so as to afford me an opportunity for practicing on the wing. He commenced, and, if that was a specimen of elocution, no wonder the Hawk drove him from the premises, for of all the earthly or unearthly sounds ever uttered, those exceeded anything I ever heard. If blind-fold, one would have supposed that there was a concert of Great Horned Owls of all ages, echoing through the forest 'waugh ho ! oo, é, ah,

'Making night hideous,'

almost tempting one to think, if not to utter, the penult of the word named. The bird without doubt recognized the vowel sounds, for she soon came around, but either not liking the looks of me or my gun, kept at a respectful distance, flying about, uttering the peculiar cry of the Marsh Hawk. Neither the attempts of Audubon or Nuttall to interpret their song has elucidated it according to my ear. It appears to me to sound like the male falsetto descending quickly from high F to D, key of two sharps, with the syllables hey, ha, ha, in compound time, accenting the first note very forcibly. The next day we went again to the swamp, but taking the precaution to conceal myself in the bushes before he commenced his elocutionary exercises, the bird dove at him as before, when he sung out lustily, 'shoot! shoot! shoot!' Discovering me the hawk changed her tactics, much to the relief of my friend, and, poising herself for a moment, dove with so much force at my head as to make a distinct rustling sound. After allowing her to repeat this several times to see if she would really take hold of my cranium, my old<sup>d</sup> gun went off, carrying death in its track, much to the joy of my companion, who now, for the first time, ventured to take a full breath since coming into the swamp."\*

**156. *Nauclerus forficatus* (Linné) Ridgway. Swallow-tailed Kite.**

A rare straggler from the South, at present. Mr. Josiah G. Ely, of Lyme, New London County, Conn., writes me that while hunting on the 2d of July (1877), one of these magnificent birds flew over his

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\* Hartford Times, chap. xv. June 29, 1861.

head, and that "there is no doubt as to its identity." Mr. W. W. Coe, of Portland, Conn., tells me that he saw a Swallow-tailed Kite in that vicinity, during the summer of 1861. He was crossing an open meadow when the Kite suddenly dove, close to where he was standing, and arose with a snake in its talons. This it devoured while in the air, much to the surprise of Mr. Coe, who was not then familiar with its habits. A specimen has also been observed in Massachusetts quite recently.\* It has been shot on Long Island (Giraud). The cause of its restricted northern range, in the eastern province, at the present time, can scarcely depend on the temperature (as generally supposed), for it was once not only common in New England, but actually wintered here. Williams, writing in 1794, says that they were then found in Vermont, and "seem to be fitted by nature, to endure all the diversity of our climate, and are to be seen in the coldest weather of our winters."† The power of wing exhibited by this splendid species is truly wonderful. Its swift flight and abrupt turnings can only be compared to those of the Swallow. I have often seen them, in Florida, dart down and pick a wasp's nest from the under side of a palmetto leaf, devouring the grubs it contained while on the wing.‡ Dr. Coues writes thus of it: "The Swallow-tailed Kite is a marked feature of the scene in the Southern States, alike where the sunbeams are redolent of the orange and magnolia, and where the air reeks with the pestilent miasm of the moss-shrouded swamps that sleep in perpetual gloom. But, imbued with a spirit of adventure, possessed of unequalled powers of flight, it often wanders far from its southern home; it has more than once crossed the ocean, and become a trophy of no ordinary interest to the ardent collector in Europe." It extends northward in the Mississippi Valley, "where it regularly occurs above the mouth of the Missouri." "Marked among its kind by no ordinary beauty of form and brilliancy of color, the Kite courses through the air with a grace and buoyancy it would be vain to rival. By a stroke of the thin-bladed wings and a lashing of the cleft tail, its flight is swayed to this or that side in a moment, or instantly arrested. Now it swoops with incredible swiftness, seizes without a pause, and bears its struggling captive aloft, feeding from its talons as it flies; now it mounts in airy circles till it is a speck in the blue ether and disappears."§

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\* *Rarer Birds of Mass.*, J. A. Allen, p. 46, 1869.

† *The Natural and Civil History of Vermont*, by Samuel Williams, p. 112, July 16, 1794.

‡ *Am. Nat.*, vol. viii, No. 2. p. 88, Feb., 1874.

§ Coues' *Birds of the Northwest*, p. 332, 1874.

157. *Accipiter fuscus* (Gmelin) Bonaparte. Sharp-shinned Hawk.

A common summer resident, breeding on trees and on high rocky cliffs throughout the State. Mr. W. W. Coe writes me, that, of all our Hawks, they are the latest to breed, laying their eggs, generally five in number, in June. He has found them "in an old grey squirrel's nest fixed up for the occasion." Arrives in March, remaining into November. F. W. Putnam, in 1856, gave it as "resident," but "not abundant," in Essex County, Mass. I have no authentic record of its occurrence here in winter. Dr. Wood writes: "Its flight is quick, irregular, and so rapid, that, if your gun is not cocked it will pass out of range before you can get aim. It pounces upon its prey with such velocity that no time is allowed for escape. While riding one day, one passed within a few feet of me and dashed into a cluster of alders, interwoven with grapevines and briars, and seized a half-grown quail, passing out with it, without scarcely checking its speed. Although the hedge was within twenty feet of me, it was so thick that I could not discern the bird until it appeared on the opposite side in the talons of the Hawk. When hungry and in search of game, it knows no fear, often diving within a few feet of you and seizing a chicken. Sometimes you will see one flying along very swift and low, wheeling right and left, taking a 'bird's-eye view' of every hedge and bush, until it starts some little bird, whose fate is surely sealed."\* Nuttall writes: "Descending furiously and blindly upon its quarry, a young Hawk of this species broke through the glass of the green-house, at the Cambridge Botanic Garden; and fearlessly passing through a second glass partition, he was only brought up by the third, and caught, though little stunned by the effort."†

158. *Accipiter Cooperi* (Bonaparte) Gray. Cooper's Hawk; Chicken Hawk.

A common summer resident, generally placing its nest in some tall pine or other high tree. "Their four eggs are usually deposited about the middle of May. They frequently build a new nest every year but often take possession of the old nest of a Red-tailed or Red-shouldered Hawk."‡ Arrives in March, remaining into November. Dr. Wood writes that he knew of six of their nests in the vicinity of East Windsor Hill, Conn., in a single season, and that he obtained

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\* Hartford Times, chap. x, May 25th, 1861.

† Nuttall's Manual of Ornithology, vol. i, p. 88. 1832.

‡ MS. notes of W. W. Coe.

eggs from five of them. He says, "It is bold and fearless, often diving within a few rods of the farmer and seizing his chickens. If once introduced to the young poultry, you may rest assured of a daily call till all are gone, unless you are fortunate enough to secure the intruder. I once saw one of these Hawks seize a chicken on a very steep side-hill, close beside the old hen. In an instant the enraged mother flew upon the thief, and both came tumbling down the hill, clinched together; running up, I was just about to grasp the Hawk when they parted. It sometimes attacks full grown poultry with success. A gentleman once informed me that, 'while standing by his wood-pile, close by the house, one of these birds dove upon a full grown rooster, within six or eight rods of him. The fowl ran some two or three rods and dropped dead. The Hawk soon returned to devour his game, as it was too heavy for him to carry away, but his audacity cost him his life.'"<sup>\*</sup>

In the old colonial days, when every man spelled as best suited his own fancy, the different kinds of Hawks did not pass unnoticed, for in 1632 Morton wrote: "There are Hawkes in New England of 5. sorts, and these of all other fether fowles I must not omitt, to speake of, nor neede I to make any Apology for my selfe, concerning any tree-pass, that I am like to make upon my judgment, concerning the nature of them, having bin bred in so genious a way, that I had the common use of them in England: and at my first arrivall in those parts practiced to take a Lannaret, which I reclaimed, trained, and made flying in a fortnight, the same being a passerger at Michaelmas. I found that these are most excellent Mettell, rank winged, well conditioned, and not tickleish footed, and having whoods, bels, luers, and all things fitting, was desirous to make experiment of that kinde of Hawke, before any other. And I am perswaded: that nature hath ordained them to be of a farre better kinde, then any that have bin used in England."<sup>†</sup> It seems to me that there is little doubt but that the above remarks refer to Cooper's Hawk.

159. *Astur atricapillus* (Wilson) Jardine. Goshawk.

Rather rare, and somewhat irregular, winter visitant. Said to breed, occasionally, as far south as Massachusetts (Maynard and Minot).

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<sup>\*</sup> Hartford Times, chap. ix, May 18th, 1861.

<sup>†</sup> New English Canaan. By Thomas Morton, p. 49. 1632. [Reprinted in Force's Hist. Tracts, vol. ii, T. 5.]

Professor Wm. D. Whitney has a finely mounted specimen, in his cabinet, which was shot, some years ago, at Hamden Plains, near New Haven, Conn. W. W. Coe, and Jno. H. Sage, of Portland, Conn., have each several fine specimens taken in the State—one near Hartford, Nov. 9th, 1867. Mr. Geo. Bird Grinnell secured one, late in the fall (Nov. or Dec.) of 1876, at Milford, Conn. For several days previous to its capture it had been in the habit of lurching on a neighbor's chickens. Mr. Erwin L. Shores writes me that, in the vicinity of Suffield, Conn., he has seen it "four or more times during the last two winters." I am informed by Dr. Wm. Wood, of East Windsor Hill, Conn., that they are really common in that vicinity about once in ten years (he once had seven specimens, in the flesh, on hand at one time) but are seldom seen between times. The doctor relates the following anecdote as illustrating well the boldness and daring often displayed by this species: An old man, over eighty years of age, was sitting quietly in the kitchen with his maiden daughter. The door was open and their quiet was suddenly broken by a hen who rushed frantically into the room, followed closely by a large Goshawk. There, right on the kitchen floor, and in the presence of the two, the bold Hawk seized the hen. The feeble old man came to the rescue, and, with stick in hand, finally succeeded in beating off the intruder, who now made for the door. But it was too late—the daughter had closed the door and actually caught the furious bird in her hands and put him to death!

Zadock Thompson says: "Its disposition is very savage, and it is withal so much of a cannibal as sometimes to devour its own young!"\* Dr. Wm. Wood, of East Windsor Hill, writes that a specimen which he once kept alive in a small room "refused food until the thirteenth day, when it devoured an entire hen. . . . It died the next night, a victim to its voraciousness."† "The poet Chaucer in alluding to it says,—

'Riding on hawking by the river,  
With gray Goshawk in hand.'

Falconry and hawking, as defined by our lexicographers, are synonymous, but formerly birds of sport were divided into two classes, those of falconry, and those of hawking. This bird came under the latter class." "The Goshawk does not usually soar high, like the longer winged Hawks, nor dart upon its prey by a direct descent, as do the

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\* History of Vermont, p. 62. 1842.

† Hartford Times, chap. ix, May 18th, 1861.

true Falcons, but by a side glance. It is restless, seldom alighting but for a moment, except to devour its quarry, and then it stands almost erect. Its flight is so rapid that it can easily overtake the swift Pigeon on the wing. . . . . When looking for prey it skims along near the surface of the ground with great velocity, and catches its game so quickly and easily as scarcely to be seen by the looker-on." "The Goshawk is the most daring and venturesome of any of our diurnal birds of prey. A farmer who resides a few miles from my office, wishing to perpetuate the old New England custom of having a chicken-pie for Thanksgiving dinner, caught some fowls, took them to a log, severed the neck of one, and threw it down beside him. In an instant a Goshawk seized the struggling fowl, and, flying off some ten rods, alighted and commenced devouring its prey. The boldness of the attack so astonished the farmer that he looked on with blank amazement. Recovering from his surprise, he hastened into the house and brought out his gun, which secured him both the Hawk and the fowl."\*

Pennant, in 1785, tells us that Goshawks "are used by the Emperor of *China* in his sporting progresses, attended by his grand falconer, and a thousand of the subordinate. . . . . The Emperor often carries a Hawk on his hand, to let fly at any game which presents itself; which are usually Pheasants, Partridges, Quails, or Cranes. *Marco Polo* saw this diversion about the year 1269."†

#### 160. *Falco communis* Gmelin. Peregrine Falcon; Duck Hawk.

Resident, but rare; breeds on Talcott Mountain, near Hartford, Conn. Linsley tells us that, previous to the year 1842, a specimen of this celebrated and powerful bird was wounded by a gun-shot in Stratford, [Conn.], and after he was taken soon recovered, and was kept on poultry until he became too expensive to the owner,"‡ who then released him. Mr. Geo. Bird Grinnell informs me that he saw, on the 23d of February, 1876, a Duck Hawk (or Great-footed Hawk, as it is often called), flying about the Sound, near Milford, Conn.

On the 29th of June, 1877, while enjoying the hospitality of Capt. O. N. Brooks, at Faulkner's Island, Conn., in company with my friend, Mr. Jno. H. Sage, the Terns breeding on Goose Island (one mile

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\* Dr. Wood, in *Am. Nat.*, vol. x, No. 3, pp. 132-4. March, 1876.

† *Arotic Zoology*. By Thomas Pennant, vol. ii, p. 204. 1785.

‡ Linsley's *Catal. Birds Conn.*, p. 250, 1843.

distant) were observed to be in an unusual state of commotion. The Captain remarked that they had been agitated, the day previous, by a Duck Hawk which might still be prowling in the vicinity, and he kindly offered to take us over there. We landed, and, on rounding the island, the Falcon suddenly started from her retreat among the rocks and weeds, which, as we afterwards discovered, was strewn with feathers. But the captain's gun was in readiness, and, through his kindness, the bird now graces my collection. During her brief visit she had made sad havoc among the Terns, and her crop was greatly distended with their remains, which had been swallowed in incredibly large pieces—whole legs, and the long bones of the wings were found entire and unbroken! Indeed she was perfectly gorged, and contained the remains of at least two adult Terns, besides a mass of newly hatched young! The only other great-footed Hawk that Capt. Brooks has ever taken, he killed, at this same place, twelve years ago. Query: did this bird come from Talcott Mountain, or did it breed far beyond our limits? It is said that they are able to fly many hours without resting, and at the enormous rate of an hundred miles per hour!\* They sometimes live nearly 200 years!

In the *Hartford Times* of June 29th, 1861, Dr. Wm. Wood, of East Windsor Hill, Conn., published the first account of the first Duck Hawk's nest found in New England. It was discovered by Dr. Moses, on Talcott Mountain, near Hartford, Conn., May 25th, 1861, and contained four young almost large enough to fly. The finding of this nest was, at the time, of particular interest, since, as Dr. Wood remarked, "it settled beyond dispute three points: 1st, that they breed on cliffs; 2d, that they breed in Connecticut; and 3d, that they nest very early" (sometime in March).†

They have since been known to breed regularly on Mount Tom, Mass., where their eggs were first taken, April 19, 1864, by Mr. C. W. Bennett,‡ of Holyoke. Their nest was again robbed, by Mr. Bennett, in 1866 and in 1869. Mr. J. A. Allen, in his "*Notes on some of the Rarer Birds of Massachusetts*," writes: "During a visit to this Mountain [Mt. Tom], in company with Mr. Bennett (Apr. 28, 1869), we had the great pleasure of discovering their second eyrie, from which, with considerable difficulty, three freshly laid eggs were obtained. Not discouraged by this second misfortune, they nested

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\* See an interesting Article in *Am. Nat.*, vol. v, No. 2, p. 82, April, 1871.

† *Hartford Times*, June 29, 1861.

‡ See *Proceed. Essex Inst.*, vol. iv, p. 153.

again, this time depositing their eggs in the old eyrie from which all except the last set of eggs have been obtained. Again they were unfortunate, Mr. Bennett removing their second set of eggs, three in number, May 23d, at which time incubation had just commenced. The birds remained about the mountain all the summer, and from the anxiety they manifested in August it appears not improbable that they had laid a third time, and at this late period had unfledged young.”\* Mr. Harold Herrick states that it is common on the Island of Grand Menan, N. B., where it “breeds on the cliffs, but in such inaccessible situations that its nest is rarely taken. There is a place between ‘Fish Head’ and the ‘Old Bishop’ known as the ‘Seven Day’s Work,’ where the cliff is divided into seven strata as sharply defined as lines of masonry. On an indentation in the face of this cliff, about one hundred feet from the top, and one hundred and fifty feet from the bottom, a pair of these Falcons have had their eyrie for a succession of years, secure alike from the assaults of the most zealous naturalist, and the small boy of bird’s-egging proclivities.”†

Mr. W. W. Coe, of Portland, Conn., tells me that while duck shooting a few years since, as the birds rose at the report of his gun, a Duck Hawk dove, struck a Teale, on the wing, and carried it off! Dr. Wood writes: “In the vicinity of their breeding places they are a terror to the poultry as well as a dread to the farmer, for there they usually hunt in pairs, one following directly after the other, and if the first one misses the game, the other is sure to pick it up; there is no escaping the two. This is the universal testimony of all the farmers living in the vicinity of the cliffs where they breed. One of my collectors went over one hundred miles to get a nest of their eggs, from only hearing a farmer in the vicinity of the cliff describe their manner of hunting; knowing from this circumstance alone that it must be the Duck Hawk.”‡

#### 161. *Falco columbarius* Linné. Pigeon Hawk.

Resident, but rare in summer, and not often seen in winter. It is not uncommon here in spring and fall. Dr. Wm. Wood tells me that he has found it about East Windsor Hill, Conn., in May, June, and July, but failed to discover the nest. He is not, of course, perfectly

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\* Notes on some of the Rarer Birds of Mass., p. 10–11, 1869.

† Herrick's Partial Catalogue of the Birds of Grand Menan, p. 10, 1873.

‡ Am. Nat., vol. v, No. 2, p. 82, April, 1871.



certain that they breed there at all, though their occurrence in early summer certainly looks like it. I have seen it, in the vicinity of New Haven, in April, and again in August and September, and now have notes of its presence in this State in every month of the year. In one of his interesting articles on the "Game Falcons of New England," Dr. Wood writes: "In May, 1860, a gentleman who resides some five miles distant, informed me that a small Hawk came almost every day and carried off a chicken for him—that it never missed, for it went so like lightning that there was no escaping its grasp. He said that it always came in the same direction from a tract of woods near his house . . . . . Accompanied by my friend, we carefully searched the woods without finding anything except the nest of the Red-shouldered Hawk. The next day the same little Hawk returned and was shot, and is now in my collection, a beautiful representative of the Pigeon Hawk. I have no doubt that it had a nest about there, as it was the season for nesting, and it always came from, and went to, the same piece of woods, and in the same direction. If it had not young it must have been carrying food to its mate while incubating. If a mere straggler it would come and go without any definite place of resort. Our inability to find the nest was not strange, as there were some sixty or eighty acres of heavy-timbered oaks and pines in the tract."\* Mr. Geo. A. Boardman states that it "breeds in hollow trees,"† which would, of course, render its nest still more difficult to find. I am strongly inclined to believe that a few pairs do occasionally breed in Connecticut, for, though its nest has not yet been actually discovered, the fact that the birds are sometimes found here throughout the entire year is strong evidence that they breed, and mere negative evidence, in such cases, amounts to little or nothing.

162. *Falco sparverius* Linné. Sparrow Hawk.

A rather rare resident; only a few pairs breed within the State, and it is seldom seen in winter. Mr. W. W. Coe tells me that it breeds near Portland, Conn., and I am informed by Dr. Wood that it sometimes breeds in the vicinity of East Windsor Hill.

Dr. Wood thus describes a novel site for a nest of this Hawk which was found at Granby, Conn.: "A farmer made a dove house inside of his barn with holes through the sides of the building com-

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\* Am. Nat., vol. vii, No. 6, pp. 342-3, June, 1873.

† Proceed. Bost. Soc. Nat. Hist., vol. ix, p. 122, Sept., 1862.

municating with it. A pair of doves that had nested there were attacked and killed by a pair of Sparrow Hawks who took possession of their nest, laid four eggs, and commenced to sit. During incubation they found the farmer's chickens very convenient for food—too much so for their own good. I saw both birds after they were killed; also their four eggs, two of which are now in my cabinet.”\* In Elizabeth, New Jersey, several years ago, I saw a pair of Sparrow Hawks fly up under the eaves of an old barn, and drag a couple of Swallows out of their nests! Mr. Sage has seen it in January (Jan. 6, 1877), near Portland, Conn., and Dr. Wood writes me that he has occasionally taken it in winter.

“Sparhawkes there are also,” wrote Morton in 1632, “the fairest, and best, shaped birds that I have ever beheld of that kinde, those that are litle, no use is made of any of them, neither are they regarded, I onely tried conclusions with a Lannaret at first comming; and when I found, what was in that bird, I turned him going: but for so much as I have observed of those birds, they may be a fitt present for a prince; and for goodnesse too be preferred before the Barbary, or any other used in Christendome, and especially the Lannars and Lannarets.”† The above may have referred to the Sharp-shinned Hawk.

163. *Buteo borealis* (Gmelin) Vieillot. Red-tailed Hawk; Hen Hawk.

A common resident, but more numerous in early spring and during the fall migrations than at other times of the year. The migrants arrive early in March, and in fall, may be seen, in considerable numbers, in September, October, and November. On the 25th of September, 1875, I saw, near New Haven, a flock of twenty-six Red-tailed Hawks, soaring high, and sailing slowly southward. The day was clear and cool, and there was little wind.

Mr. W. W. Coe, of Portland, Conn., has been remarkably fortunate in finding the nests of this Hawk, having taken, during the past five years, nearly forty of its eggs! The best time to go for them seems to be about the middle of April, but he has found nests, containing eggs, at all dates from March 30th (1875) to May 23d (1878), though the young generally hatch during the latter part of April or early in May. The Stadtmüller brothers found a nest, near New Haven, April 13, 1877, containing three eggs which “were just beginning to

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\* Am. Nat., vol. viii, No. 5, p. 268, May, 1874.

† New English Canaan, p. 50. [Reprinted from Force's Hist. Tracts, vol. ii, T. 5.]

hatch.”\* The Red-tailed Hawk generally lays two, frequently three, and sometimes four, eggs. In writing of them, from Portland, Conn., Mr. Coe says: “Their nests are easily identified, being the largest nests built in this locality, and the earliest. They lay in the same nest year after year if not disturbed, and often if they are. I once found a nest in a young chestnut, not over twenty feet from the ground, but they commonly build high up in large trees.”†

The Rev. Mr. Peabody, in his Report on the Birds of Massachusetts (in 1839), remarked that these Hawks, “like the Crow, seem to have an intuitive perception of the use and reach of the gun, for if they see a person armed, they give a scream of disgust, and sail away far beyond his reach.”‡

They are often called Hen Hawks from their frequent visits to the poultry yard. I have also found, in their alimentary canals, the remains of mice, snakes, and frogs.

#### 164. *Buteo lineatus* (Gmelin) Jardine. Red-shouldered Hawk.

A common resident, like the last, but more frequently seen in winter. Also breeds in high trees. Mr. Coe writes me that it generally lays a little later than the Red-tail, makes a smaller nest, and is more likely to build a new one every year. He has taken their eggs from April 16th (only one egg, just deposited) till May 19th. They generally lay three or four eggs, and sometimes five. Dr. Wood once found six! I once took from the stomach of one of these Hawks a snake (*Eutainia saurita*) measuring twenty-two inches in length!

A young bird, which Dr. Wood raised, became very much attached to him. He says: “by giving a whistle he would answer with his *ka-hee, ka-hee, ka-hee*, and fly from the tree and alight on my shoulder, expecting his accustomed morsel. I did not confine him at all, but allowed him to fly where he pleased, knowing that he would not go far off. The domestic fowls became so well acquainted with him that they showed no signs of fear when he alighted on a tree or post near them. One morning he did not come at my call, nor at noon. In the afternoon I went in search of him and whistled till my lips would not pucker any longer, yet no bird answered to the music. The next morning he was brought to me as a rare specimen with the following

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\* MS. notes of the Stadtmüller Brothers.

† MS. notes of W. W. Coe.

‡ A Report on the Ornithology of Massachusetts, by William B. O. Peabody, p. 268, 1839.

sequel: 'He came and alighted on my fence within a few feet of me when I was feeding my fowls. They flew in every direction. Carefully stepping up I caught the pretty creature and thought I would save him for the doctor. Putting him into a box, I gave him some corn; but he did not seem hungry, and would not eat a kernel.'"\* Again, under the name of "Winter Hawk (*Buteo hyemalis*)," the doctor continues: "Sitting patiently upon a tree near some spring or marshy ground, it will watch by the hour for a frog to make its appearance, when it is immediately seized and drowned. There is a side-hill, some few miles from my office, from which springs constantly run in the coldest weather, forming quite a wet, marshy place, offering great inducements to the Winter Hawk. Here you may see one or more of these birds every winter, perched upon a tree near by watching for its favorite food. I received two specimens shot from that tree in one day."†

165. *Buteo Pennsylvanicus* (Wilson) Bonaparte. Broad-winged Hawk.

A rather rare resident, seldom seen in winter. It breeds sparingly about New Haven, and Mr. W. W. Coe has taken quite a number of their nests, together with several of the finest specimens of the bird that I have ever seen, in the vicinity of Portland, Conn. He informs me that they generally lay later than the Red-shouldered Hawks, and, like them, often build a new nest every year.

Mr. F. W. Putnam (in 1856) gave it as a rare winter visitant so far north as Essex Co., Mass.‡

166. *Archibuteo lagopus*, var. *Sancti-Johannis* (Gmelin) Ridgway.  
Rough-legged Hawk; Black Hawk.

A winter visitor; not common. I saw one near New Haven, Nov. 20th, 1875. Mr. Geo. Bird Grinnell tells me that he has seen it, in spring, near North Haven, Conn. It is sometimes quite abundant on the low meadows bordering the Connecticut River, where, in the vicinity of East Windsor Hill, Conn., Dr. William Wood has secured a large number of specimens. The splendid series thus obtained, enabled him, many years ago, to prove the identity of the two forms, *lagopus* and *Sancti-Johannis*, then considered, by our

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\* Hartford Times, chap. xii, June 8th, 1861.

† Hartford Times, chap. xiii, June 15th, 1861.

‡ Proceed. Essex Inst., vol. i, p. 203, 1856.

best Ornithologists, to be specifically distinct. As long ago as 1861 Dr. Wood published the following: "The difference in size is no more than frequently occurs in birds of the same species. The shape and general form, the small claws, the same habits in every respect, their arrival at the same time, associating and sailing together, the plumage of the one running into the other as it changes, so that it is difficult, if not impossible, to tell where the dividing line comes, some being jet-black, others not quite as dark, others slightly mixed, some more so, certainly make a strong case in favor of their identity."\* Three years later the doctor wrote J. A. Allen that he had then taken and examined about forty specimens, and could now state positively that: "The Rough-legged Falcon and Black Hawk *are the same.*"† Both Baird and Coues, in their late works on our birds, state that the examination of a large number of specimens leaves little doubt as to the identity of the two forms under consideration, each using such language as to indicate an original discovery dependant on his own investigations, and neither alludes to the published records of Dr. Wood, who, long before, arrived at the same conclusion, and from a larger amount of material, and of better quality, than is to be found in any other collection in the world.

167. *Pandion haliaëtus* (Linné) Cuvier. Fish Hawk; Osprey.

A summer resident, breeding abundantly along the coast, both on the main land and on islands in the Sound. It is particularly abundant during the spring migrations. It arrives late in March (March 28, 1877), remaining through October (Oct. 23). The migrants pass northward during the latter part of April, and return again in September. Mr. Fred. Sumner Smith, of this city, tells me that a friend of his found a Fish Hawk's nest in Heron Swamp (near New Haven) as late as July 4th, (1870). It was a small one, being little larger than a bushel basket, was placed in a clump of thick bushes, and contained three eggs. Mr. W. W. Coe informs me that they do not breed so far up the Connecticut River as Middletown and Portland, but are common at its mouth (about Saybrook), and that he has taken their nests, along the Sound, all the way from Saybrook to New London, Conn. "Immense numbers of them breed regularly at Plumb Island, Conn., where I saw, last spring, at least five hundred nests, and over a thousand birds. There is only one small piece of

\* Hartford Times, chap. xiv, June 22d, 1861.

† Allen's notes on some of the Rarer Birds of Mass., p. 14. 1869.

timber on the island, and every tree contains a Fish Hawk's nest, or from eight to ten Night Herons' nests. There is quite a colony of Night Herons there. There not being trees enough for the Hawks to nest in, many of them build on the ground and some lay their eggs in the sand. They occupy the same nest for years, adding a little to it each season, till some of them, that were originally placed flat on the ground, had become so large that I could not look into them. Many were seven feet high and measured six or eight feet across the top! On the 4th of June I found both young birds and fresh eggs in some of the nests. The Crow Blackbirds had built their nests in among the large sticks on the sides of the Fish Hawk's nests, there being often four or five of the former placed about the sides of one of the latter. Besides the Fish Hawks, Night Herons, and Crow Blackbirds, many other birds breed upon this island, among which might be mentioned the Upland and Killdeer Plover, and large numbers of Terns."\*

The Rev. Wm. B. O. Peabody, in 1839, thus wrote of their habits: "The Fish Hawk is on excellent terms with the fishermen, though they are of the same trade. Its coming announces the arrival of the shoals of fish that crowd our rivers in the spring. Perhaps its exemption from persecution may be owing also to its well known gentleness of disposition. Unlike other birds of prey, the Fish Hawks are social and friendly to each other. They come to us in flocks of eight or ten, who build near each other, and rear their young in perfect harmony, and this spirit of hospitality and kindness is extended to other birds that seem to have no claim upon them. The Crow Blackbirds are permitted to shelter in the interstices of their nests, which are huge constructions, made of a cartload of heavy materials firmly matted together."†

#### 168. *Aquila chrysaëtus* Linné. Golden Eagle.

A rare winter visitant. Dr. Wood informs me that it is sometimes seen about Hartford, Conn. Mr. J. N. Clark, of Saybrook, Conn., writes me that he sees one or two there every year, and that one remained in that vicinity a week, about the middle of May last (1877). One was secured at Deep River, Conn., Nov. 13th, 1875, by Mr. Harry Flint. Zadock Thompson stated that they sometimes live in Vermont, and says that "the nest is placed upon the inaccessible shelf of some

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\* MS. notes of W. W. Coe.

† Peabody's Report on the Ornithology of Mass., p. 265. 1839.

rugged precipice, and consists of a few sticks and weeds barely sufficient to keep the eggs from rolling down the rocks. . . . These eagles feed upon young fawns, hares, raccoons, wild turkeys, partridges, and other quadrupeds and birds, but will feed on putrid flesh only when severely pressed by hunger.”\*

169. *Haliaëtus leucocephalus* (Linné) Savigny. Bald Eagle.

A resident; not uncommon during the migrations. Saw one flying over the city, Nov. 20th, 1875. Also observed five individuals during Feb. and March, 1876. They unquestionably breed about four miles above the mouth of the Housatonic River, Conn., as I am told by my friend, Mr. Geo. Bird Grinnell. One was shot near the mouth of the East Haven River in Nov., 1876, and is now in the collection of Mr. Thomas Osborne of this city. Used to breed in suitable localities throughout the State, and there were formerly two eyries within a few miles of New Haven, one at Mt. Carmel, and the other on Salton-stall Ridge.†

Linsley kept an immature specimen (called by him “Washington’s Eagle”) alive for some time, concerning which he writes: “I kept him awhile confined, but soon found it unnecessary, because if he left my premises he would return to the stand at night. I have known him to eat fourteen birds (mostly King-birds), and then he was satisfied for a week. He appeared to prefer this mode of living, and paid no attention to a daily supply. He, however, in the course of the summer, became so mischievous among the young ducks of my neighbors, that I was compelled to kill him. A single anecdote of his conduct may not be uninteresting: While he had possession of my front yard, occupying the centre as his stand (the walks making a semicircle to the door), he would remain perfectly quiet if *gentlemen* or *ladies* entered; but if a person with tattered garments, or such persons as were not accustomed to come in at the front door, entered the yard, it was actually dangerous for them, and they could only escape the tremendous grasp of his talons by running with their full strength and shutting the gate after them. Facts of this kind often occurred, and I was occasionally compelled to release from his grasp such individuals as he had taken captive. With one claw in the sward and grass, he would hold quietly any man with the other.”

\* History of Vermont, by Zadock Thompson, p. 59, 1842.

† Am. Jour. Sci. and Arts, vol. xliv, No. 2, p. 251, April, 1843.

In 1634, William Wood wrote: "The Eagles of the Countrey be of two sorts, one like the Eagles that be in *England*, the other is something bigger, with a great white head and white taylor: these be commonly called Gripes; these prey upon Duckes and Geese, and such Fish as are cast upon the Sea-shore. And although an Eagle be counted King of that feathered regiment, yet is there a certaine blacke Hawke that beates him; so that he is constrained to soare so high, till heate expell his adversary."\*

### Family, CATHARTIDÆ.

#### 170. *Cathartes aura* (Linné) Illiger. Turkey Buzzard.

A rare visitor from the South, at present, although once "not uncommon"† according to Linsley, who further states: "I have known it in Connecticut from a child, having at that period counted twenty in a flock in Northford in the month of August." "At the South, where they abound, it is seldom one attacks domestic poultry; but many years since I saw in Northford, in this State, a splendid male Turkey Buzzard pounce down upon a chicken about three-quarters grown, and within about three rods of where I was standing with two other persons. As he turned his eye upon us, still standing upon the chicken, he appeared so much alarmed as to be unable to rise; we all ran upon him, and when within a few feet of him he rose, just clearing our heads, and dropping the chicken at our feet, he hurried off."‡ This fact is particularly interesting, since they are commonly believed to feed exclusively on carrion. Nuttall heard that they were "accused, at times, of attacking young pigs and lambs, beginning their assault by picking out the eyes." But that he did not believe it is evident, for he goes on to say: "Mr. Waterton, however, while at Demerara, watched them for hours together amidst reptiles of all descriptions, but they never made any attack upon them. He even killed lizards and frogs and put them in their way, but they did not appear to notice them till they had attained the putrid scent. So that a more harmless animal, living at all upon flesh, is not in existence, than the Turkey Vulture."§ Nevertheless, since our own mod-

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\* New England's Prospect, p. 30, 1634.

† Regarding its former abundance, Mr. J. N. Clark writes me that an old hunter told him "that they used to be very common" about the mouth of the Connecticut, where "he had shot a good many, but not recently."

‡ Am. Jour. Sci. and Arts, vol. xlv, No. 2, p. 250, April, 1843.

§ Nuttall's Manual of Ornithology, p. 45, 1832.



ern classification of the Animal Kingdom is not sufficiently plastic to admit of grouping together chickens, pigs, and lambs, under the head of "Reptiles," along with "lizards and frogs," and the like, and since the word of so careful and conscientious an observer as Mr. Linsley is unimpeachable, we are forced to admit that these "harmless animals" do occasionally visit the farm-yard with "malice aforethought," and that a young fowl, safely lodged in the otherwise empty stomach, may not prove an altogether distasteful article, exerting, perchance, as soothing an effect over the sluggish intellect of one of these indolent scavengers as the most delicious morsel of putrescent carrion. Indeed, Audubon says of it: "they often watch the young kid, the lamb, and the pig, issuing from the mother's womb, and attack it with direful success." "Any flesh that they can at once tear with their very powerful bill in pieces, is swallowed, no matter how fresh; . . . but it frequently happens that these birds are forced to wait until the hide of the prey gives way to the bill."\* Mr. Grinnell tells me that one was shot at the mouth of the Housatonic River, Conn., in June, 1875, by C. Merwin, of Milford Point. Turkey Buzzards have been observed at Saybrook, Conn., by Mr. J. N. Clark) recorded by Purdie;† two were taken in Massachusetts,‡ and one even strayed as far to the north as Calais, Maine, where it was captured by Mr. G. A. Boardman (recorded by Prof. A. E. Verrill).§ Dr. Wood tells me that one was seen, feeding on carrion, near East Windsor, Conn., only three years ago (1874). The Rev. J. Howard Hand writes me as follows, concerning the occurrence of Turkey Buzzards in Connecticut: "I took one specimen at Cromwell, Conn., Sept. 23d, 1874; also one at Westbrook, Conn., Oct. 16th, 1875, and again eight specimens on Oct. 18th (two days afterwards). They are not common." Dr. Wm. O. Ayres writes me that he took one at New Haven in 1853.

Along our eastern coast it does not breed farther north than Southern New Jersey; but in the West its range is much more extensive, its northern limit being "about 53° in the region of the Saskatchewan, where it arrives in June,"|| and was obtained by Sir John Richardson. Dr. Coues saw it at Fort Randall, Dakota, lat. 43° 11', and I have

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\* Appendix to Wilson's American Ornithology, vol. iv, pp. 254 and 258, 1831.

† Am. Nat., vol. vii, No. 11, p. 693, Nov., 1873.

‡ Samuel's Descriptive Catalogue of the Birds of Massachusetts, p. 3, 1864. [From Agr. Mass., App., p. xviii, 1863.]

§ Proc. Bost. Soc. Nat. Hist., vol. ix, p. 122, Sept., 1862.

|| Coues' Birds of the Northwest, p. 380, 1874.

myself observed it in Idaho, Wyoming, and Utah. It was once common throughout New England, as attested by numerous old writers. Josselyn must have been blessed with a keen appetite and an admirable digestion, for he says: "The turkie-buzzard, a kind of kite, but as big as a turkie; brown of color, and very good meat."\*

NOTE.—The Black Vulture, *Cathartes atratus* (Ray) Lesson, may sometimes occur as a rare straggler from the South; and the Rev. J. Howard Hand writes me that he thinks he has killed three specimens of it at Westbrook, Conn. (Aug. 10, Sept. 12 and 21, 1874), but they may have been young Turkey Buzzards. Unfortunately the specimens were not preserved. Several individuals have been recorded from Massachusetts,† and it has even straggled as far north as Maine (Calais, G. A. Boardman)‡ and Nova Scotia.

### Family, COLUMBIDÆ.

#### 171. *Ectopistes migratoria* (Linné) Swainson. Wild Pigeon.

Sometimes quite abundant during the migrations. A few breed (late in May). Arrives about the first of April (Apr. 2, 1875, Sage). Mr. Coe tells me that numbers of them bred about Portland, Conn., in 1875, and that a few generally nest there.

Concerning the enormous flocks of Wild Pigeons which passed to and fro over the country in former years (and which, on a smaller scale, are still to be met with in some parts of the West), Gov. Thomas Dudley wrote, as early as 1631: "Vpon the 8 of March, from after it was faire day light, untill about 8 of the clock in the forenoone, there flew over all the tounes in our plantacons soe many flocks of doues, each flock conteyning many thóusands and some soe many that they obscured the lighte, that it passeth credit, if but the truth should bee written, and the thing was the more strange, because I scarce remember to have seene tenne doues since I came into the country. They were all turtles as appeared by diverse of them wee killed flying, somewhat bigger than those of Europe, and they flew from the north east to the south west; but what it portends I know not."§ And in the following year (1632), Thomas Morton, of Clif-

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\* New England's Rarities Discovered. By John Josselyn, p. 11, 1672.

† Coes' List of the Birds of New England, p. 6, 1868; J. A. Allen's Rarer Birds of Mass., p. 47, 1869; etc.

‡ Am. Nat., vol. iii, p. 498, Nov., 1869.

§ Reprinted in Force's Historical Tracts, Tract 4, p. 17-18.

ford's Inn, speaking of his impressions of the country, when first he landed in New England, said: "The more I looked the more I liked it. And when I had more seriously considered of the bewty of the place, with all her faire indowments, I did not thinke that in all the knowne world it could be paralel'd." "Contained within the volume of the Land, Fowles in abundance, Fish in multitude, and discovered besides; Millions of Turtledoves one the greene boughes: which sate pecking, of the full ripe pleasant grapes, that were supported by the lusty trees, whose fruitfull loade did cause the armes to bend, which here and there dispersed (you might see) Lillies and of the Daphnean-tree, which made the Lande to mee seeme paradise, for in mine eie, t'was Natures Master-peece."\*

In looking over a curious old pamphlet, printed in 1630, and entitled "New-England's Plantation. Or, a Short and true description of the Commodities and discommodities of that countrey. Written by a reuerend'Diuiue now there resident.", I find the following notice of the Wild Pigeon: "In the Winter time I haue seene Flockes of Pidgeons, and haue eaten of them: they doe flye from Tree to Tree as other Birds doe, which our Pidgeons will not doe in *England*: they are of all colours as ours are, but their wings and tayles are farr longer, and therefore it is likely they fly swifter to escape the terrible Hawkes in this Countrey."† Samuel Williams, in his *Natural and Civil History of Vermont* (published in 1794), writes as follows: "In the Wild Pigeon, the multiplying power of Nature acts with great force and vigour. The male and female always pair: They sit alternately upon the eggs, and generally hatch but two at a time; but this is repeated several times in a season.—The accounts which are given of the number of pigeons in the uncultivated parts of the country, will appear almost incredible to those who have never seen their nests. The surveyor, *Richard Hazen*, who ran the line which divides Massachusetts from Vermont, in 1741, gave this account of the appearances, which he met with to the westward of Connecticut river. 'For three miles together the pigeon's nests were so thick, that five hundred might have been told on the beech trees at one time; and could they have been counted on the hemlocks, as well, I doubt not but five thousand at one turn round.' The remarks of the first settlers of Vermont, fully confirm this account. . . . The settlement of the country has since set bounds

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\* Reprinted in Force's *Historical Tracts*, Tract 5, p. 42.

† Reprinted in Peter Force's *Historical Tracts*, vol. i, Tract 12, p. 11.

to this luxuriance of animal life; diminished the number of these birds, and drove them further to the northward.”\*

Two centuries after Morton's description was written, Nuttall remarks: “To talk of hundreds of millions of individuals of the same species habitually associated in feeding, roosting, and breeding, without any regard to climate or season as an operating cause in these gregarious movements, would at first appear to be wholly incredible. . . . . The approach of the mighty feathered army with a loud rushing roar, and a stirring breeze, attended by a sudden darkness, might be mistaken for a fearful tornado about to overwhelm the face of nature. For several hours together the vast host, extending some miles in breadth, still continues to pass in flocks without diminution. The whole air is filled with them; their muting resembles a shower of sleet, and they shut out the light as if it were an eclipse. At the approach of the Hawk, their sublime and beautiful aerial evolutions are disturbed like the ruffling squall extending over the placid ocean; as a thundering torrent they rush together in a concentrating mass, and heaving in undulating and glittering sweeps towards the earth, at length again proceed in lofty meanders like the rushing of a mighty animated river.” “Alighting, they industriously search through the withered leaves for their favorite mast [chiefly beech nuts and acorns]; those behind are continually rising and passing forward in front in such quick succession, that the whole flock, still circling over the ground, seems yet on the wing. As the sun begins to decline they depart in a body for the *general roost*, which is often hundreds of miles distant, and is generally chosen in the tallest and thickest forests almost divested of underwood. Nothing can exceed the waste and desolation of these nocturnal resorts; the vegetation becomes buried by their excrements to the depth of several inches. The tall trees, for thousands of acres, are completely killed, and the ground strewed with many branches torn down by the clustering weight of the birds which have rested upon them. The whole region for several years presents a continued scene of devastation, as if swept by the resistless blast of a whirlwind.”† Wilson tells us that their breeding places are still more extensive than the roosts, mentioning one in Kentucky “which stretched through the woods in nearly a north and south direction; was several miles in breadth, and was said to be upwards of forty miles in extent!” “On some single trees

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\* The Natural and Civil History of Vermont, p. 114, 1794.

† Nuttall's Manual of Ornithology, vol. i, pp. 631-2, 1832.

upwards of one hundred nests were found, each containing *one* young only,"\* though undoubtedly two eggs are always laid—the one hatching first and crowding the other out of the nest, which is, at best, but a frail cradle, formed merely "of a few slender dead twigs, negligently put together, and with so little art that the concavity appears scarcely sufficient for the transient reception of the young,"† which, like the eggs, may readily be seen from below, through the delicate net-work of twigs. Wilson says it was dangerous to walk under these flying and fluttering millions, from the frequent fall of large branches, broken down by the weight of the multitudes above, and which, in their descent, often destroyed numbers of the birds themselves; while the clothing of those engaged in traversing the woods were completely covered with the excrements of the Pigeons." "The ground was strewed with broken limbs of trees, eggs, and young squab Pigeons, which had been precipitated from above, and on which herds of hogs were fattening. Hawks, Buzzards, and Eagles, were sailing about in great numbers, seizing the squabs from their nests at pleasure."‡ Audubon's description of a night passed at one of their roosting places deserves introduction here: Reaching it early in the afternoon, before the pigeons had come in, "many trees two feet in diameter" were observed "broken off at no great distance from the ground; and the branches of many of the largest and tallest had given way, as if the forest had been swept by a tornado." "Everything proved," continued Audubon, "that the number of birds resorting to this part of the forest must be immense beyond conception. As the period of their arrival approached, their foes [man] anxiously prepared to receive them. Some were furnished with iron pots containing sulphur, others with torches of pine-knots, many with poles, and the rest with guns. The sun was lost to our view, yet not a pigeon had arrived. Everything was ready, and all eyes were gazing on the clear sky, which appeared in glimpses amidst the tall trees. Suddenly there burst forth a general cry of 'here they come!' The noise which they made, though yet distant, reminded me of a hard gale at sea, passing through the rigging of a close-reefed vessel. As the birds arrived and passed over me, I felt a current of air that surprised me. Thousands were soon knocked down by the pole men. The birds continued to pour in. The fires were lighted, and a magnificent, as well as wonderful, and almost terrifying, sight presented itself. The Pigeons, arriving by thousands,

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\* American Ornithology, by Alexander Wilson, vol. ii, pp. 295–6. Edinburgh, 1831.† Wilson, *ibid.*, pp. 295–6.‡ Nuttall, *ibid.*, p. 633.

alighted everywhere, one above another, until solid masses were formed on the branches all around. Here and there the perches gave way under the weight with a crash, and, falling to the ground, destroyed hundreds of the birds beneath, forcing down the dense groups with which every stick was loaded. It was a scene of uproar and confusion. I found it quite useless to speak, or even to shout to those persons who were nearest to me. Even the reports of the guns were seldom heard, and I was made aware of the firing only by seeing the shooters reloading. . . . . The Pigeons were constantly coming, and it was past midnight before I perceived a decrease in the number of those that arrived. . . . . Towards the approach of day the noise in some measure subsided; long before objects were distinguishable the Pigeons began to move off in a direction quite different from that in which they had arrived the evening before; and at sunrise all that were able to fly had disappeared. The howling of the wolves now reached our ears, and the foxes, lynxes, cougars, bears, raccoons, opossums, and pole-cats were seen sneaking off, whilst Eagles and Hawks of different species, accompanied by a crowd of Vultures, came to supplant them, and enjoy their share of the spoil." Two farmers, "distant more than a hundred miles, had driven upwards of three hundred pigs to be fattened on the Pigeons which were to be slaughtered."\*

"Audubon attempts to reckon the number of Pigeons in one of these flocks, and the daily quantity of food consumed by it. He takes, as an example, a column of one mile in breadth, and supposes it passing over us, without interruption, for three hours, at the rate of one mile per minute. This will give us a parallelogram of 180 miles by 1, averaging 180 square miles; and, allowing two Pigeons to the square yard, we have one billion one hundred and fifteen millions one hundred and thirty-six thousand Pigeons in one flock: and as every Pigeon consumes fully half a pint per day, the quantity required to feed such a flock must be eight millions seven hundred and twelve thousand bushels per day!"†

"Indeed, for a time," Nuttall correctly remarks, "in many places nothing scarcely is seen, talked of, or eaten, but Pigeons!"

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\* *The Birds of America*, by John James Audubon, vol. v, pp. 29-30.

† Wilson, *ibid*, Appendix, vol. iv, p. 323

172. *Zenædura Carolinensis* (Linné) Bonaparte. Carolina Dove;  
"Turtle Dove."

A rather common summer resident, sometimes remaining through the winter (Jan. 15, 1874; 16, 1875, Grinnell). Arrives early in May (May 5, 1875, shot, Sage). On May 24th, 1876, I found a nest containing two fresh eggs, on a maple sapling, fifteen feet above the ground. In the south and west they generally, though by no means exclusively, breed on the ground.\* In central Massachusetts I have taken it as late as the middle of November (1873). It is particularly abundant throughout the far west, and near the Pacific coast has been seen as far north as "lat. 49° in summer, while a few winter in California"† about San Francisco, latitude 38°. Mr. Stadtmüller found a nest of this species, about twelve feet from the ground, in a pine grove, near New Haven, June 20th, 1874. "It was close to the trunk of the tree, and consisted of a few sticks placed loosely on top of a common squirrel's nest, and contained one egg and one young dove. I took the egg and four weeks later went to get the nest, but found another egg in it."‡ Surely the squirrel's nest must have been deserted, or it would hardly have constituted a safe base for bird's eggs.

NOTE.—The Wild Turkey, *Meleagris gallopavo*, var. *Americana* (Bartram) Coues, long since exterminated from this State, was once common here. Wild Turkeys were plenty in 1780, and occasionally seen as late as 1790.§ Regarding their former abundance in New England, one Thomas Morton, of Clifford's Inn, Gent., wrote (printed by Charles Green, in 1632): "Turkies there are, which divers times in great flocks have sallied by our doores; and then a gunne (being commonly in a redinesse) salutes them with such a courtesie, as makes them take a turne in the Cooke roome. They daunce by the doore so well. Of these there hath bin killed, that have weighed forty-eight pound a peece. They are by mainy degrees sweeter than the tame Turkies of England, feede them how you can. I had a salvage who hath taken out his boy in a morning, and they have brought home

\* Vide: Coues' Birds of the Northwest, p. 389, 1874; Allen, Bull. Mus. Comp. Zool., vol. iii, No. 6, p. 170, 1872; Cooper, Ornithology of California, p. 513, 1870; Merriam, Zool. Report in 6th Annual Report U. S. Geol. Survey Terr., p. 710, 1872; Henshaw, Report upon Ornithological Specimens, p. 68, 1874.

† Cooper, Ornithology of California, p. 513, 1870.

‡ MS. notes of the Stadtmüller Brothers.

§ A Statistical Account of the County of Middlesex, in Connecticut, by David D Field, p. 19. 1819.

their loads about noone. I have asked them what number they found in the woods, who have answered neent metawna, which is a thousand that day; the plenty of them is such in those parts. They are easily killed at rooste, because the one being killed, the other sit fast neverthesse, and this is no bad commodity.”\* Linsley says: “The last Wild Turkey that I have known in Connecticut, was taken by a relative of mine, about thirty years since [about 1813], on Totoket Mountain, in Northford. It was overtaken in a deep snow, and thereby outrun. It weighed, when dressed, twenty-one pounds.”† In 1842, Zadock Thompson wrote that a few “continue still to visit and breed upon the mountains in the southern part of the State” (Vermont).‡ As late as 1833 it was “frequently met with on Mt. Holyoke,” but had “become scarce and nearly extinct” in other parts of the State.§ Professor Wm. D. Whitney once mounted a fine specimen of the Wild Turkey killed on Mt. Tom, Mass., Nov. 1st, 1847. It may now be seen in the beautiful case of birds given by Prof. Whitney to the Peabody Museum of Yale College, and is of particular value as being, in all probability, the last of its race seen in that State. In the month of October, “the *Turkey Moon* of the aborigines,” they used to wander far and wide in quest of food, frequently assembling in vast numbers in districts where there was an abundance. Audubon tells us that “When they come upon a river, they betake themselves to the highest eminences, and there often remain a whole day, or sometimes two, as if for the purpose of consultation. During this time the males are heard gobbling, calling, and making much ado, and are seen strutting about, as if to raise their courage to a pitch befitting the emergency. Even the females and young assume something of the same pompous demeanor, spread out their tails, and run round each other, *purring* loudly, and performing extravagant leaps. At length, when the weather appears settled, and all round is quiet, the whole party mount to the tops of the highest trees, whence, at a signal, consisting of a single *chuck*, given by a leader, the flock takes flight for the opposite shore.”||

Josselyn says “their eggs are very wholesome and restore decayed nature exceedingly.”¶

\* Reprinted in Force's Historical Tracts, Tract 5, p. 48.

† Am. Jour. Sci. and Arts, vol. xlv, No. 2, p. 264. April, 1843.

‡ History of Vermont, Natural, Civil, and Statistical. By Z. Thompson, p. 101. 1842.

§ See Hitchcock's Report, p. 549. 1833.

|| Audubon's Birds of America, vol. v, p. 43.

¶ Two Voyages to New England, p. 99. 1675.



## Family, TETRAONIDÆ.

173. *Bonasa umbellus* (Linné) Stephens. Ruffed Grouse.

A common resident. Breeds on both East and West Rock, near New Haven, as well as throughout the State. In May, 1877, Prof. Verrill found a nest, containing twelve eggs, within ten feet of a traveled road, near the city. In the vicinity of Easthampton, Mass., they were particularly abundant, and on one occasion I frightened one off from an apple tree directly behind the "Town Hall." Large numbers of them are caught in snares every fall, and the market is well supplied with native birds. Of it, in 1632, Morton wrote: "Partridges, there are much, like our Partridges of England, they are of the same plumes, but bigger in body. They have not the signe of the horseshoe-shoe on the breast as the Partridges of England; nor are they coloured about the heads as those are; they sit on the trees. For I have seene 40. in one tree at a time; yet at night they fall on the ground, and sit until morning so together; and are dainty flesh."\*

174. *Ortyx Virginianus* (Linné) Bonaparte. Quail; Bob White.

A common resident, breeding in thick brushwood at South End and many other places near New Haven.

This species also attracted Morton's attention, for he says: "There are quailles also, but bigger then the quailles in England. They take trees also: for I have numbered 60. upon a tree at a time. The cocks doe call at the time of the yeare, but with a different note from the cock quailles of England."\*

NOTE.—The Prairie Chicken, or Pinnated Grouse, *Cupidonia cupido* (Linné) Baird, was formerly a resident of New England, but, like the Wild Turkey, was exterminated many years ago—at least so far as the main land is concerned, for it is said that a few still exist on some of the islands south of Cape Cod (Naushon for example, and perhaps Martha's Vineyard). However, it is pretty certain that many years have elapsed since the last "wild chicken" was seen in Connecticut, for even Linsley, in 1842, gave it as a bird of the past. Nuttall, ten years earlier (in 1832), said that they were still met with "on the brushy plains of Long Island, and in similar shrubby barrens

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\* Force's Historical Tracts, vol. ii, Tract 5, p. 48.

*in Westford, Connecticut.*"\* That our ancestors were fond of "fowling," and that it sometimes cost them their lives, may be seen from the following: In October, 1636, one "Joseph Tilly, master of a bark, came to anchor nearly opposite Calve's Island, and taking one man with him, went on shore for the purpose of fowling. As soon as he had discharged his piece, a large number of Pequots, rising from their concealment, took him and killed his companion; and then gratified their malice by putting him to torture. They first cut off his hands and then his feet; after which he lived three days. But as nothing which they inflicted upon him excited a groan, they pronounced him a stout man."† And this occurred in the town of Saybrook, Conn., at a time when many of our forefathers perished at the hands of the Indians, before bringing them to submission. One Thomas Morton, writing in 1632, speaks of the presence of this bird in New England in the following language: "There are a kinde of fowles which are commonly called Pheisants, but whether they be pheysants or no, I will not take upon mee, to determine. They are in form like our pheasant-henne of England. Both the male and the female are alike; but they are rough footed: and have stareing feathers about the head and neck, the body is as bigg as the pheysant-henne of England; and are excellent white flesh, and delicate white meate, yet we seldom bestowe a shoot at them."‡ The "white flesh" must have been a mistake unless he referred to the Ruffed Grouse which is immediately spoken of under the name of "Partridge." Nuttall says of its habits: "The season for pairing is early in the spring, in March or April. At this time the behavior of the male becomes remarkable. Early in the morning he comes forth from his bushy roost, and struts about with a curving neck, raising his ruff, expanding his tail like a fan, and seeming to mimic the ostentation of the Turkey. He now seeks out or meets his rival, and several pairs at a time, as soon as they become visible through the dusky dawn, are seen preparing for combat."§

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\* Manual of Ornithology, vol. i, p. 662. 1832.

† A Statistical Account of the County of Middlesex, in Connecticut. By David D. Field, p. 36. 1819.

‡ Force's Historical Tracts, vol. ii, Tract 5, p. 48.

§ Nuttall's Manual of Ornithology, vol. i, pp. 663-64. 1832.

## Family, CHARADRIIDÆ.

175. *Squatarola helvetica* (Linné) Brehm. Black-bellied Plover.

Occurs during the migrations. Taken at Stratford by Linsley. Mr. W. W. Coe has a splendid specimen of this bird, taken in fall, on the Sound near the mouth of the Connecticut. Dr. F. W. Hall shot several specimens about the middle of October (Oct. 18, 1873), and tells me that they were remarkably tame.

176. *Charadrius fulvus*, var. *Virginicus* (Bork.) Coues. Golden Plover.

Common during migrations. Capt. Brooks informs me that they are "plenty at Guilford, Conn., in spring and early fall," and that "sometimes a few stop in the fall and stay a few days" at Faulkner's Island. Linsley found it at Stratford. Mr. Coe has taken it as far inland as Portland, Conn., on the river.

177. *Ægialitis vocifera* (Linné) Bonaparte. Killdeer Plover.

A summer resident, but not very common. It generally arrives late in March (Feb. 24, 1875, plenty by last of March; April 5, 1872; Portland, Conn., W. W. Coe). Mr. Coe informs me that it breeds on Plumb Island, and in the vicinity of Portland, Conn., where it used to be very common.

178. *Ægialitis Wilsonia* (Ord) Cassin. Wilson's Plover.

Not common. Linsley took it at Stratford. It has also been taken on Long Island (Giraud), but seldom strays so far North.

179. *Ægialitis semipalmata* (Bonap.) Cabanis. Semipalmated Plover.

A common migrant. Arrives about, or before, the middle of May (May 17, 1876, Osborne). During the latter part of May, and first of June, they may be seen, in small flocks, running along the beach, in search of food, as the tide goes out. Mr. W. W. Coe writes me that he has taken it at Portland, Conn., twenty-five miles from the Sound.

180. *Ægialitis meloda* (Wilson) Bonaparte. Piping Plover; Ringneck.

A summer resident. Linsley found it breeding at Stratford. Mr. J. N. Clark also finds it breeding at Saybrook, Conn., and Mr. W. W. Coe has taken it at Portland.

## Family, HÆMATOPODIDÆ.

181. *Hæmatopus palliatus* Temminck. Oyster-catcher.

A rare migrant. Linsley says: "The Oyster-catcher is now rare here, but fifteen years since they were not very uncommon in autumn."\*

182. *Streptilas interpres* (Linné) Illiger. Turnstone.

A common migrant. Linsley gave it from Stratford, and Capt. Brooks writes me that it is "quite common in spring and fall" about Faulkner's Island, Conn. Mr. Sage, of Portland, has a beautiful male, which he killed at Westbrook, Conn., May 23d, 1877. In fall it returns during the latter part of August (Aug. 31, 1874, F. W. Hall).

## Family, RECURVIROSTRIDÆ.

183. *Recurvirostra Americana* Gmelin. Avocet.

A rather rare migrant. Josiah G. Ely, Esq., writes me that he has seen but one specimen of the Avocet taken on our coast. "It was caught, in 1871, between Saybrook and East Lyme, in an old seine strung out on the beach to dry," and was kept alive for some time by a storekeeper.

## Family, PHALAROPODIDÆ.

184. *Steganopus Wilsoni* (Sabine) Coues. Wilson's Phalarope.

Of rare and almost accidental occurrence in New England, though common throughout the West. Linsley says of it: "Wilson's Phalarope I have in my cabinet; it was killed in Bridgeport [Conn.] and sent to me by a friend, and is probably one of the rarest birds in New England. It is not only beautiful, but the great quantity of plumage on a bird so small and delicate, together with his unique bill, seems to render it one of the most peculiar of this class of animals."†

185. *Phalaropus fulicarius* (Linné) Bonaparte. Red Phalarope.

A rare visitor from the North. Mr. W. W. Coe has a specimen in his cabinet, killed at Portland, Conn., in September.

\* Am. Jour. Sci. and Arts, vol. xlv, No. 2, p. 265. April, 1843. † Op. cit., p. 268.

## Family, SCOLOPACIDÆ.

186. *Philohela minor* (Gmelin) Gray. Woodcock.

A resident; common from early spring till November. A few commonly, if not regularly, winter in low swamps. They arrive early in March ("Mar. 3, 1877, Middletown, Conn., killed by flying against a telegraph wire"\*), and breed very early. On the 3d of April, 1877, my young friend, Walter R. Nichols, found, near Branford, Conn., a nest containing four fresh eggs. They may breed twice, for Mr. Nichols found a second nest, in the same locality, and containing the same number of eggs, as late as July 20th, 1877. The eggs were partially incubated, and the old bird was shot as she left the nest. Mr. W. W. Coe writes that he found one, near Portland, Conn., April 12, 1872, also containing four eggs: "The nest was on a bog, in the middle of a brook which ran through a swamp. It was not more than six inches above the water. The grass was short, and there were no bushes near, so that it was very much exposed, but still hard to find, for, although we had hunted the ground over carefully, the old bird did not fly off until my man stepped on the bog. I had my old dog Dincks with me, and his nose is first class, and yet he passed within a foot of her several times without scenting her, which satisfies me that a bird sitting on her eggs gives out no scent, for this is not the first time I have tried it. The nest was simply a shallow hole scraped in the top of the bog; there was a little coarse grass, a few leaves, and one or two of the Woodcock's feathers in it."† Mr. John H. Sage tells me that, while collecting with Mr. W. W. Coe near Portland, Conn., May 30th, 1874, they flushed a Woodcock with young, one of which she carried off in her claws! and Mr. Coe writes me, "in regard to the Woodcock carrying off its young: Mr. Sage and I were not four feet apart when the old bird got up between us, rose about three feet, and then dove down again and picked up a young bird with her feet, and, with her tail spread and held forward under the young, carried it off about eight rods, and came back for the others, but my boy frightened her away."

Thomas Morton, in 1632, thus alluded to the resemblance between our bird and the European Woodcock (*Scolopax rusticola*): "Simpes, there are like our Simpes in all respects, with very little difference. I have shot at them onely, to see what difference I could finde be-

\* MS. notes of John H. Sage.

† MS. notes of W. W. Coe.

tweene them and those of my native country, and more I did not regard them.”\*

187. *Gallinago Wilsoni* (Temminck) Bonaparte.      Wilson's Snipe.

A resident; common during the migrations; sometimes breeds. In October and November (some remain into December) large numbers are shot on our salt marshes. Mr. W. W. Coe took it Feb. 4th, 1872, near Portland, Conn., and thinks they sometimes winter there in low swampy places. Arrives in March (Mar. 18, 1874, Sage). Mr. W. Coe and Mr. J. H. Sage inform me that they took a nest containing three fresh eggs of this species at Portland, Conn., May 13th, 1874. The eggs were “fully identified, as the parent bird was found on the nest.”† It was not previously known to breed as far south as Connecticut. The nearest approach to it is “a set of eggs in the Smithsonian labeled Oneida Co., N. Y.”‡ Mr. Coe tells me that there were a number of Snipe in the field at the time, and he thinks there were other nests which they did not find.

188. *Macrorhamphus griseus* (Gmelin) Leach.      Red-breasted Snipe.

Not rare during the migrations. “Stratford,” Linsley. Mr. J. H. Sage of Portland has a specimen which he shot at Saybrook, Conn., Aug. 21st, 1874.

189. *Ereunetes pusillus* (Linne) Cassin.      Semipalmated Sandpiper.

A summer resident; common along the shore during the migrations. Mr. W. W. Coe has seen it in June. On the 20th of July, 1877, Mr. Walter R. Nichols found, at Branford, Conn., four eggs of a small Sandpiper. They were placed on a few straws in a slight excavation in a corn field, about half a mile from the shore. Supposing them to be the eggs of this species I sent one to Dr. Brewer, who writes: “In the absence of my cabinet, for comparison, I cannot be certain, but I have little or ~~no~~ doubt that it is the egg of *Ereunetes pusillus*.” It is unnecessary to state that this is the first authentic record of its breeding in southern New England. In fall, Dr. F. W. Hall has taken it as early as Aug. 25th (1874).

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\* Reprinted in Force's Historical Tracts, vol. ii, Tract 5, p. 47.

† MS. notes of John H. Sage, Esq.

‡ Coues' Birds of the Northwest, p. 476.

190. *Tringa minutilla* Vieillot. Least Sandpiper.

A common migrant. Maritime. Found along the shore in May and early June, and again in August and September.

191. *Tringa maculata* Vieillot. Pectoral Sandpiper; Jack Snipe.

Common during migrations. Mr. Coe tells me that it is common in fall as far up the Connecticut as Middletown. Arrives from the north early in August (Aug. 6, 1873, Hall).

192. *Tringa fuscicollis* Vieillot. Bonaparte's Sandpiper; White-rumped Sandpiper.

Not rare during migrations, though Linsley took only two specimens at Stratford, Conn. Dr. Hall has taken it late in August (Aug. 31, 1874).

193. *Tringa maritima* Brunnich. Purple Sandpiper.

Not uncommon during the migrations. Many winter on the islands along the coast. Not found by Linsley. Captain Brooks writes me from Faulkner's Island that "Purple Sandpipers come here in early fall and stay till spring," and that they are common and get to be quite tame.

194. *Tringa alpina*, var. *Americana* Cassin. Dunlin; "Ox-Bird."

A common migrant; a few may winter.

195. *Tringa subarquata* (Guld) Temminck. Curlew Sandpiper.

A rare visitor along our coast. Mr. Josiah G. Ely writes me that one was shot near Saybrook, Conn., some time ago, and I am informed by Dr. D. Crary, of Hartford, that a specimen of this species was killed, Oct. 3d, 1859, at Keeny's Cove, on the Connecticut River, in East Hartford (Hockanum), Conn. Also, Dr. E. L. R. Thompson, of this city, tells me that he shot three Curlew Sandpipers on the Quinipiac River (near New Haven) in June, 1874. Dr. Wm. O. Ayres, now of Easthampton, Long Island, writes me that he "killed it once at Miller's Place, L. I., in 1839,"\* and it has also been taken in Massachusetts.†

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\* See also Giraud's *Birds of Long Island*, 1844.

† Catalogue of the Birds of New England. By T. M. Brewer, p. 13. 1875.

196. *Tringa canutus* Linné. Red-breasted Sandpiper; Knot.

Common during migrations. Taken at Saybrook, by Mr. Sage, Aug. 21st, 1874; and Mr. Coe tells me that it is found about the Connecticut River, near Middletown, in summer.

NOTE.—The Stilt Sandpiper, *Micropalama himantopus* (Bonap.) Baird; and Baird's Sandpiper, *Tringa Bairdii* Coues, doubtless occur along the coast during migrations.

197. *Calidris arenaria* (Linné) Illiger. Sanderling.

Occurs during migrations, and is extremely abundant in fall. Linsley took it at Stratford. Mr. Grinnell informs me that they arrive during the latter part of September, remaining late into October. Thomas Morton wrote of them in 1632: "Sanderlings are dainty bird, more full bodied than a Snipe, and I was much delighted to feede on them, because they were fatt, and easie to come by, because I went but a stepp or to for them: and I have killed betweene foure and five dozen at a shoot which would lead me home. Their foode is at ebbing water on the sands, of small seeds, that grows on weeds there, and are very good pastime in August."\*

198. *Limosa fedoa* (Linné) Ord. Great Marbled Godwit.

A rare migrant. Linsley found it at Stratford, Conn., in August, 1842, "in large flocks, but very shy."† Nearly an hundred years ago, Thomas Pennant, in his Arctic Zoölogy, stated that "it inhabits Hudson's Bay and Connecticut."‡

199. *Limosa Hudsonica* (Latham) Swainson. Hudsonian Godwit.

A rare migrant. Taken at Stratford by Linsley. Coues suggests that the *Limosa Edwardsii*? of Linsley (p. 267) is "perhaps an albino"§ of this species, but Pennant thought it was the Avocet (*Recurvirostra Americana*).|| The good old preacher (Linsley), in speaking of these birds, could not take his Lord's name in vain on so slight a provocation—hence he called them "Goodwits."

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\* New English Canaan, p. 47, 1632. Reprinted in Force's Historical Tracts, vol. ii, Tract 5.

† Am. Jour. Sci. and Arts, vol. xlv, No. 2, p. 267, 1843.

‡ Arctic Zoölogy, vol. ii, p. 465, 1785.

§ List of the Birds of New England, p. 48, 1868.

|| Arctic Zoölogy, vol. ii, p. 502, 1785.



**200. *Totanus semipalmatus* (Gmelin) Temminck. Willet; Tattler.**

A summer resident; not common. Linsley found it breeding at Stratford, Conn. Mr. Grinnell has taken it, near Milford, late in the summer, and Mr. W. W. Coe took a nest, containing three eggs, at Madison, Conn., June 5th, 1873.\*

**201. *Totanus melanoleucus* (Gmelin) Vieillot. Greater Yellow-legs.**

Common during migrations. Arrives in May (May 14, 1874, Sage), remaining till June (June 1, 1877, Sage). Found both coastwise and in the interior. I first became acquainted with it at Yellowstone Lake, where I killed four at one shot, Aug. 23d, 1872.

**202. *Totanus flavipes* (Gmelin) Vieillot. Lesser Yellow-legs.**

A common migrant. Killed one May 7th, 1877, on a fresh water pond near Meriden, Conn. Returns about the middle of August (Aug. 17, 1874, Hall).

NOTE.—*Totanus chloropus* Nilsson. Green-shanlis.

Linsley states that a specimen of this rare straggler was taken at Stratford, Conn., in the autumn of 1842.† This is, so far as I am aware, the only recorded instance of its capture north of Florida (Audubon shot three on Land Key, Fla., May 28, 1832),‡ where its occurrence seems to be purely accidental, its proper home being in the "Old World;" and since Dr. Coues states that it was given by Linsley "very possibly through an erroneous identification,"§ I do not feel justified in including it among the species ascertained to occur within our limits.

**203. *Totanus solitarius* (Wilson) Audubon. Solitary Tattler.**

Common during the migrations. Arrives early in May (May 2, 1877), frequenting muddy ponds and sluggish streams, in small flocks of about half a dozen. Solitary individuals may be seen as late as early June, (Coe; June 10, Grinnell).

**204. *Tringoides macularius* (Linne) Gray. Spotted Sandpiper.**

A common summer resident, arriving during the latter part of April or first of May (May 1, 1874, Sage). I once found its nest

\* MS. notes of W. W. Coe, Esq.

† Am. Jour. Sci. and Arts, vol. xlv, No. 2 p. 266, 1843.

‡ Audubon's Birds of North America, vol. v, p. 321.

Proceed. Essex Inst., vol. v, p. 296, 1868.

within eight feet of a railroad track where trains passed every hour of the day! Remains into October (Oct. 6, 1874). Found wherever there is a pond or small stream.

205. *Actiturus Bartramius* (Wilson) Bonap. Bartramian Sandpiper;  
"Upland Plover."

A common summer resident. Breeds in open fields away from water. I am informed by Mr. Coe that large numbers of them breed on Plum Island, off New London, Conn. Arrives about May 1st (May 2, 1874, Portland, Conn., Sage).

206. *Tryngites rufescens* (Vieillot) Cabanis. Buff-breasted Sandpiper.

Occurs during the migrations, but is not common. Josiah G. Ely, Esq., writes me that two were killed near Saybrook, a few years ago, and Dr. Daniel Crary had one in his collection which "was shot near Hartford some years ago."

207. *Numenius longirostris* Wilson. Long-billed Curlew.

Not particularly rare during migrations, but excessively shy. Linsley took it at Stratford, Conn. Regarding its occurrence near Faulkner's Island, Conn., Capt. Brooks writes: "Not plenty; occasionally one stops here in the fall." It was seen at Milford, Conn., by Mr. Grinnell, during the summer of 1873. Mr. J. N. Clark, of Saybrook, Conn., tells me that it sometimes occurs there in the fall, but is rare. Dr. Crary tells me that it has been taken near Hartford, Conn.

208. *Numenius Hudsonicus* Latham. Hudsonian Curlew.

A rare migrant. Taken at Stratford, Conn., by Linsley. I am informed by Dr. Crary, of Hartford, Conn., that it has been killed in that vicinity. Under date of "July 20, 1877," the Rev. J. Howard Hand writes me, from Southampton, Long Island: "Have just taken three specimens of the Hudsonian Curlew this morning."

209. *Numenius borealis* (Forster) Latham. Eskimo Curlew.

Not common. Occurs during migration. Taken at Stratford, Conn., by Linsley. Mr. J. N. Clark has a fine mounted specimen in his cabinet, killed at Saybrook, Conn., Oct. 13, 1874.

## Family, TANTALIDÆ.

210. *Ibis falcinellus*, var. *Ordii* (Bonaparte) Coues      Glossy Ibis

A rare accidental visitor from the South. At Stratford, Conn., Linsley obtained five specimens of this species.\* Stragglers have also been taken in Massachusetts. There is a specimen of this species in the Museum of Wesleyan University, at Middletown, Conn., taken in that vicinity, by Dr. Barrat about the year 1855.

211. *Ibis alba* (Lunne) Vieillot      White Ibis

One only recorded from New England. It was seen by Mr. Geo. Bird Grinnell within ten miles of New Haven: "Late in the afternoon of May 23, [1875] I observed near Milford, Conn., a specimen of *Ibis alba*. I recognized the bird as it flew over me, and following it to a small pond where it went down, discovered it perched upon a tree over the water. I carefully examined it with a good glass, at a distance of about one hundred and fifty yards, and by this means was enabled to note every detail of form and color. It was in full plumage, the white being pure, and the naked skin about the head, bright red. After watching it for a few moments I tried to approach it, but before I came within gunshot it flew, uttering a hoarse cackle as it went off."† Two specimens have been killed on Long Island.‡

## Family, ARDEIDÆ.

212. *Ardea herodias* Linné      Great Blue Heron.

A summer resident. Common during the migrations. Arrives before the middle of April (Apr. 4, 1873, Coe; 12, Sage), and I have seen it as late as Nov. 28th (1875), along the coast. On April 17th, 1877, Mr. A. J. Dayan and I saw about a dozen of these splendid birds on the Whitney Lakes, within a couple of miles of New Haven, but they were very shy and remained only a few days. Mr. Grinnell once saw a flock of twenty-eight flying over the Sound. Mr. W. P. Nichols saw one near New Haven, June 2d, 1877.

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\* Am. Jour. Sci. and Arts, vol. xlv, No. 2, p. 266, 1843.

† Am. Nat., vol. ix, No. 8, p. 470, 1875.

‡ Giraud's Birds of Long Island, p. 275, 1844.

213. *Ardea egretta* (Gmelin) Gray      Great White Egret.

A rare visitor from the South. Several specimens have been taken in Massachusetts, and I have myself seen it at the "Ox Bow" on the Connecticut. A specimen was shot near Middletown, Conn., some years ago, and is now in the Museum of Wesleyan University. Mr. Grinnell has seen it on the marshes near Milford, Conn., in September. Dr. Wood tells me that, several years ago, one spent a week on a marsh near East Windsor Hill, Conn. Mr. Fred. Sumner Smith tells me that he saw a pair of these birds at Lake Saltonstall (near New Haven), Conn., during the latter part of July, 1876, and two weeks later, at the same place, saw no less than seven individuals feeding together. They were exceedingly shy and he could not approach within gunshot.

214. *Ardea candidissima* (Jacquin) Gmelin      Little White Egret

A rare accidental visitor from the South. Seen at Stratford, Conn., by Linsley. Also taken in Massachusetts, and one straggler even reached Nova Scotia ("Jones"). Dr. Cray says that he has taken it near Hartford, Conn.

215. *Ardea cærulea* Linné      Little Blue Heron.

A very rare accidental visitor from the South. Linsley took it at Stratford, Conn. Has been taken in Massachusetts. Mr. Dayan saw a small Heron on Lake Whitney, early in April, 1877, which he supposes to have been this species. In the Cabinet of Mr. Coe, of Portland, Conn., is a beautiful specimen of this species which he shot in that vicinity early in July, 1875. It was a young bird and is pure white all over, excepting the tips of the primaries, which show a little slate-blue color. There were two of them together, but the other escaped. Mr. Erwin I. Shores, of Suffield, Conn., writes me that one was shot there about the middle of May by Mr. Chas. Newton. Mr. Shores did not see the specimen, but says: "Dr. Newton described it to me as 'a small Heron blue all over,' and I have no doubt but that it was this species."

216. *Ardea virescens* Linné      Green Heron.

A common summer resident. Breeds in several places near New Haven—notably in "Pine Swamp." Arrives late in April or early in May (May 3), remaining into October. Capt. Brooks informs me

that they sometimes stop at Faulkner's Island in spring. Breeds late in May and in early June.

217. *Nyctiardea grisea*, var. *nævia* (Boddert) Allen. Night Heron.

A common summer resident. Breeds in Pine and Heron Swamps, near New Haven, and in several other places about the State, and on islands off the coast. Mr. A. J. Dayan started a small flock on Lake Whitney, April 24th, 1877, and they alighted on a tree. On his near approach all took flight but one, which he brought down, and an examination proved that it had a well marked cataract in the eye facing the direction from which he approached. This is an interesting fact in Ornithological pathology. Remains into October. Mr. W. W. Coe, of Portland, Conn., on the 17th of April, 1872, visited a "*Heronry*" of this species, at Rocky Hill, Conn. He writes: "Saw hundreds of nests, each containing from two to five eggs. Eight and even ten nests were frequently found on one tree, and the same nest often contained fresh eggs, eggs half hatched, and young birds. The trees were white from the excrements of the birds, and looked as if they had all been whitewashed; nothing could grow under them."\*

NOTE.—The Yellow-crowned Night Heron (*Nyctiardea violacea*) has been taken in Massachusetts, by Mr. Vickery (Oct., 1862),† and doubtless occurs as a rare accidental visitor.

218. *Botaurus minor* (Gmelin) Boie. Bittern; Stake-driver.

A common summer resident. Arrives in April (Apr. 26, 1875, Sage), remaining till November. Linsley relates the following amusing anecdotes concerning this species: "I obtained a fine specimen of the American Bittern two years since, which had previously given great alarm to many of our inhabitants by its peculiarly doleful and mournful sounds at evening. One man who was laboring near the swamp, it is said, ran a mile in the greatest consternation, alleging that 'the d—l was after him.' It is also stated by several of our most respectable inhabitants, that forty-seven years since, [1796] one hundred men united in a company on the Sabbath to traverse this swamp, and succeeded in killing one of these same birds, and that their sounds have not been heard in town since, until the former instance occurred which secured a specimen to me."‡

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\* MS. notes of W. W. Coe, Esq.

† Allen, Rarer Birds of Massachusetts, p. 39, 1869.

‡ Am. Jour. Sci. and Arts, vol. xlv, No. 2, p. 265, 1843.

219. *Ardetta exilis* (Gmelin) Gray. Least Bittern.

The Least Bittern seems to be, at present, a pretty regular summer resident, though formerly regarded as an accidental visitor. Linsley gave it from Northford, Conn., without comment. It has certainly bred here for several years past, and on June 27th, 1876, Mr. Nichols found its nest at Branford, Conn., containing one fresh egg. I have seen it in September. They were particularly abundant throughout the State during the season of 1875. Mr. W. W. Coe, who has seven beautiful specimens in his cabinet, showed me five eggs which he took from a nest at Portland, Conn., June 14th, 1873, and says that they breed regularly in that vicinity. Mr. Geo. Bird Grinnell also tells me that he takes two or three every year (generally in August or September). They follow up the Connecticut Valley to Massachusetts (Suffield, Conn., July, E. I. Shores).

NOTE.—The Sand-hill Crane, *Grus Canadensis* (Linné) Temm., though not occurring in New England at the present time, even as a rare straggler, was once common here. Thomas Morton, writing of the birds of New England, in 1632, says, of "Cranes, there are greates store, that even more come there at S. Davids day, and not before: that day they never would misse. These sometimes cate our corne, and doe pay for their presumption well enough; and serveth there in powther, with turnips to supply the place of powthered beefe, and is a goodly bird in a dishe, and no discommodity."\* The fact that they ate corn, and were themselves, in turn, eaten by the inhabitants, clearly shows, as Prof. J. A. Allen has said, "that the Crane, and not a Heron, is the bird to which reference is made."† Moreover, Samuel Williams, more than an hundred and fifty years later (in 1794), says that the Sand-hill Crane ("*Ardea Canadensis*") was among the commonest of the "Water Fowl" found in Vermont at that time.‡ Belknap also gives it, in 1792, as one of the birds of New Hampshire.§ And even so recently as 1842, Zadock Thompson wrote that the Whooping Crane, *Grus Americana* (Linné) Temminck, was "occasionally seen during its migrations,"|| in Vermont.

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\* New English Canaan. Printed by Charles Greene, 1632. Reprinted in Force's Historical Tracts, vol. ii, Tract 5, pp. 47-8.

† Bull. Nutt. Ornith. Club, vol. i, No. 3, p. 58. Sept., 1876.

‡ The Natural and Civil History of Vermont, p. 119. 1794.

§ The History of New Hampshire, vol. iii. By Jeremy Belknap, p. 169. 1792.

|| History of Vermont, p. 103. 1842.

The present distribution of the Sand-hill Crane is interesting from its peculiarity. Common throughout the West, they extend northward even into Alaska, breeding about the Yukon (Dall),\* but are not found east of the Mississippi Valley, except in Florida, where I have seen them, both on the Ocklawaha River,† and flying over the St. Johns. Both Mr. Grinnell‡ and myself§ found them to be abundant in the Yellowstone National Park, though so wary that it was difficult to obtain a shot at them. They were particularly numerous in the Lower Geyser Basin, in August, and used to make such an unnecessary amount of noise, mornings, that sleep, after daylight, was well nigh out of the question. Showing a decided preference for the grassy meadows (called "Parks," in the West) surrounded by heavy forests, and marking, perhaps, the course of some mountain stream, which is content to check its headlong speed while passing through a neighboring valley, the Sand-hill Crane, ever on the alert, keeps well away from the trees, and at the approach of any suspicious object, at once takes flight, uttering its warning cry for the benefit of those of its kind who happen to be near. The flats which they frequent are often studded with wooded knolls, and the best way to hunt them is to betake one's self, in company with a good rifle, to one of these "Islands" before the fog rises in the morning, and remain concealed and perfectly quiet. When the fog lifts, the stately forms of the Cranes may be seen scattered over the meadows, always peering about in search of danger; but at least one is pretty sure to be within rifle range. And at the report the alarm is given and the others lose no time in beating a hasty retreat. Their flight is heavy, and seemingly laborious. To their edible qualities I can testify with a good grace. The flesh is really excellent, deep red in color, and not unlike that of the Beaver. Few birds are more difficult to skin.

Thomas Pennant, in his *Arctic Zoölogy* (1785) says that "they arrive in May about Severn River, Hudson's Bay. Frequent lakes and ponds. Feed on fish and insects. Hatch two young; and retire southward in autumn.¶ I must observe, that they formerly made a halt in the Hurons country, at the season in which the Indians set their maize; and again on their return from the North, when the harvest was ready, in order to feed on the grain. The Indians, at

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\* *Alaska and its Resources*. By William H. Dall. Appendix G, p. 583. 1870.

† *Am. Nat.*, vol. viii, No. 2, p. 89. Feb., 1874.

‡ *Ludlow's Report* for 1875, p. 87.

§ *Hayden's Report* for 1872, p. 702.

¶ *Ph. Trans.*, lxii. 409.

those times, were used to shoot them with arrows headed with stone; for Theodat,\* my authority, made his remarks in that country in the beginning of the last century.”†

### Family, RALLIDÆ.

#### 220. *Rallus longirostris* Boddert. Clapper Rail.

Not common. Taken at Stratford by Linsley, who remarks that it “breeds abundantly” there.‡ Frequents *salt* marshes. Recently recorded from Massachusetts by Mr. Purdie. “The bird was captured by its flying on board a vessel in the [Boston] harbor, May 4, 1875.”§

Several well authenticated instances of its occurrence in Connecticut have recently come to my notice.

#### 221. *Rallus elegans* Audubon. King Rail

Rather rare. Found breeding at Stratford, by Linsley.‡ Frequents *fresh-water* marshes. Mr. W. W. Coe has taken it at Portland, Conn. Mr. J. N. Clark of Saybrook, Conn., has a fine specimen in his cabinet taken there in *mid-winter* (Jan. 14, 1876).

#### 222. *Rallus Virginianus* Linné. Virginia Rail.

A common summer resident, breeding plentifully in both salt and fresh-water marshes. They are quite abundant in the brackish-water marshes bordering the Quinnipiac River, and here my friend, Mr. Dayan, found a nest containing seven fresh eggs and secured the old bird, on June 7th, 1876. Concerning the nocturnal proclivities, and shrill, startling cry of the Rail, Dr. Coues thus graphically writes: “At nightfall some Mallard and Teal settled into the rushes, gabbling curious vespers as they went to rest. A few Marsh Wrens had appeared on the edge of the reeds, queerly balancing themselves on the thread-like leaves, sea-sawing to their own quaint music. Then they were hushed, and as darkness settled down, the dull, heavy croaking of the frogs played bass to the shrill falsetto of the insects. Suddenly they too were hushed in turn, frightened, may be, into silence; and from the heart of the bullrushes, ‘*crik-crik-rik-k-k-k*,’

\* As quoted by De Buffon.

† Arctic Zoölogy, vol. ii, p. 443. 1785.

‡ Am. Jour. Sci. and Arts, vol. xliv, No. 2, p. 267, 1843.

§ Bull. Nutt. Ornith. Club, vol. ii, No. 1, p. 22, January, 1877.



lustily shouted some wide-awake Rail, to be answered by another and another, till the reeds resounded. Then all was silent again till the most courageous frog renewed his pipes. The Rail are, partially at least, nocturnal. During such moonlight nights as these they are on the alert, patrolling the marshes through the countless covered ways among the reeds, stopping to cry 'all's well' as they pass on, or to answer the challenge of a distant watchman. That they feed by night as well as by day, cannot be doubted. Their habit of skulking and hiding in the almost inaccessible places they frequent renders them difficult of observation, and they are usually considered rarer than they really are."\*

223. *Porzana Carolina* (Linné) Cabanis. Carolina Rail; Sora.

An abundant summer resident. Large numbers are killed each year for the market. Have seen them as late as October (1874). Found both in fresh and salt-water marshes where there is an abundant growth of "Bullrushes," "Cat tails" and the like. Linsley says of it: "The Carolina Rail was so abundant here [Stratford, Conn.] last Autumn, in the marshes of the Housatonic, that something like hundreds were killed in a few hours, and that too for several days together. They were esteemed a great delicacy."† Regarding the difficulty of seeing them in their favorite haunts, Mr. Maynard writes: "I have been in a swamp where there were literally thousands of them, yet was unable to start more than two or three!"‡ I have had many similar experiences. One will suffice: Well do I remember finding a Rail's nest in a marshy swail near the mouth of a small cañon at the foot of the Wahsatch Range, just back of Ogden, Utah. It was early in June, and the nest, which was large and bulky, being composed of coarse marsh grass, was hidden in a clump of flags, whose arching blades met overhead, so concealing the enclosed treasures that they could only be seen by stooping over and peering through a small opening in the side, left for the passage of the parent bird. As yet but two eggs had been deposited, and the bird stole so silently and quickly through the reeds that I hardly felt sure it was not a snake till careful search revealed the nest. The next thing to be done was to secure the old bird, and with this end in view the place was visited at least once each day

\* Coues, *Birds of the Northwest*, pp. 537-8, 1874.

† *Am. Jour. Sci. and Arts*, vol. xlv, No. 2, p. 267, April, 1843.

‡ *Maynard's Naturalists' Guide*, pp. 145-46, 1873.

all the middle of June, but, notwithstanding the fact that I exercised the greatest caution in approach, I never so much as caught a momentary glimpse of her form, though once or twice a shadow seemed to flit hurriedly by and disappear in plain sight. What made it still more remarkable was that the number of eggs kept increasing day by day, and I always found them warm, showing that the bird had been gone but an instant. Once, while feeling of the eggs, I was so startled by her harsh crackling cry, uttered suddenly at my very feet, that I came near breaking them all, but still saw nothing of her. The time had come when we must move camp, so on the 15th of June I made a final effort to secure the old bird. The nest now contained twelve eggs, and I fancied I could hear the faint peeping of a young bird in his attempt to extricate himself from the shell. Stepping back a few paces, I waited, gun in hand, for the space of two long hours, standing first on one leg, then on the other, like a bashful country boy, till my patience was nearly exhausted and I was on the point of leaving, when something darted quickly toward the nest—it was enough; the mangled remains sufficed to determine the species. Meanwhile the egg had fairly hatched, and its noisy contents had already gained no little use of its tiny twigs. How the first hatched youngsters amuse themselves during the ten days, or two weeks, whilst the other eggs are coming to maturity, will doubtless be fully elucidated by he who attempts to explain how it is that a bird can give origin, in the course of a couple of weeks, to a dozen of eggs, each nearly as large and heavy as her own body. Certain it is that the processes of digestion, and assimilation of nutriment, must go on in them much more rapidly than in ourselves.

Wilson remarked that, "Of all our land or water fowl, perhaps none afford the sportsman more agreeable amusement, or a more delicious repast, than the little bird now before us. This amusement is indeed temporary, lasting only two or three hours in the day for four or five weeks in each year." The mode of procedure is thus described: "The sportsman furnishes himself with a light batteau, and a stout experienced boatman, with a pole of twelve or fifteen feet long, thickened at the lower end to prevent it from sinking too deep into the mud. About two hours or so before high water they enter the reeds, and each takes his post, the sportsman standing in the bow ready for action, the boatman on the stern seat pushing her steadily through the reeds. The Rail generally spring singly, as the boat advances, and at a short distance ahead, are instantly shot down, while the boatman, keeping his eye on the spot where the bird fell,

directs the boat forward and picks it up while the gunner is loading. . . . . In this manner the boat moves steadily through and over the reeds, the birds flushing and falling, the gunner loading and firing, while the boatman is pushing and picking up. . . . . In these excursions it is not uncommon for an active and expert marksman to kill ten or twelve dozen in a tide!"\* Mr. Grinnell informs me that the same method of hunting is practiced on the marshes bordering the Housatonic River, Conn.

224. *Porzana Noveboracensis* (Gmelin) Cassin. Yellow Rail.

Not common. Taken at Stratford, Conn., by Linsley. Though one of the rarer birds, it breeds about Middletown, Conn., as I am informed by Mr. Coe, who took it there in 1874 and 1875. Mr. Thos. Osborne has a specimen killed near New Haven. Mr. Grinnell favors me with the following note concerning its occurrence on the marshes near Milford, Conn.:

DEAR MERRIAM--The specimens of *Porzana Noveboracensis* about which you enquire were taken for the most part during the month of October, 1876, although I procured one individual as late as Nov. 10th. The securing of the first two or three was quite accidental.

I was working a young setter on Snipe (*Gallinago Wilsoni*) on a piece of wet meadow near Milford, Conn., and several times during the early part of the day was annoyed by the pertinacious way in which the dog would trail up some bird which neither he nor I could start. At length during one of these performances I saw the puppy grasp at something in the bogs before him, and immediately a small Rail rose and fluttered a few yards. Noticing its small size, and the fact that it had some white on its wings, and seeing from its flight that it was a Rail, I shot the bird before it had gone far, and when it was brought by the dog I was delighted to see that it was *P. Noveboracensis*, a species which I had never before seen alive. During the day several more individuals were secured. The next opportunity that I had of looking for these birds was, I think, Oct. 14th. That day my brother and I secured eight in an hour or two. They were ridiculously tame and would run along before the dog, creeping into the holes in the bogs and hiding there while we tried in vain to start them. I killed one with my dog whip, caught one alive in my hand, and the dog brought me another, uninjured, which he had

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\* Wilson's American Ornithology, vol. iii, p. 115, 1831.

caught in his mouth. From what I saw of their habits, I am convinced that the only successful way of collecting these birds is to look for them with a dog. Without one they could never be forced from the ground. Yours sincerely,

GEO. BIRD GRINNELL.

**225. *Porzana Jamaicensis* (Gmelin) (assin.      Black Rail.**

An extremely rare summer resident. But three specimens of this rare bird have as yet been obtained in New England. The second Connecticut record is that given by Mr. H. A. Purdie, who writes: "Of this species Mr. Clark, of Saybrook, Conn., writes me that a neighbor of his, while mowing at that place, July 10th, 1876, swung his scythe over a nest of ten eggs on which the bird was sitting, unfortunately cutting off the bird's head and breaking all but four of the eggs."\* I have recently seen the eggs in question, in Mr. Clark's collection. They agree precisely with Cones' description of the eggs of this bird, "being creamy-white, sprinkled all over with fine dots of rich, bright reddish-brown," and are totally unlike those of any other species of Rail. The bird was not preserved, but there seems to be no reasonable doubt of its identity. Mr. Purdie further states that he has "lately seen a skin of this species belonging to Mr. Browne, of Framingham. The bird was picked up dead, in August, 1869, by a relative of his, on Clark's Island, Plymouth Harbor [Mass.], and was forwarded to him as something entirely new to our shores. This instance adds a new bird to the Fauna of Massachusetts."\* The only other recorded instance of its capture in New England is that given by Dr. Thos. M. Brewer: "Hazenville, Conn., Batty."

**226. *Gallinula galeata* (Licht.) Bonaparte      Florida Gallinule.**

A rather common summer resident, as I am told by Mr. Grinnell, who has taken a number of specimens about Milford, Conn. Mr. W. W. Coe has also taken it near Portland, Conn.

**227. *Porphyrio Martinica* (Linné) Temminck.      Purple Gallinule.**

A rare accidental visitor from the South. A specimen of this species was killed near Middletown, Conn., about the year 1855, and is now in the Museum of Wesleyan University. It has been taken in Massachusetts, as recorded by G. P. Whitman: "A fine specimen

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\* Bull. Nutt. Ornith. Club, No. vol ii, 1, p. 22, January, 1877.

of the Purple Gallinule was shot at 'Henry's Pond,' 'South-end,' Rockport, Mass., on April 12th, [1875] by Mr. Robert Wendell."\*

228. *Fulica Americana* Gmelin. Common Coot; Mud Hen

Common during the migrations, particularly in fall. May breed. Linsley took five specimens at Stratford, remarking that it was "by no means common" there. Last October (1876), my friend, Mr. A. J. Dayan, shot several on Lake Whitney, and ascertained that no less than fifty specimens were killed there during that month!

Family, ANATIDÆ.

229. *Cygnus Americanus* Sharpless Whistling Swan.

A rare, almost accidental, visitor, occurring only in winter. Linsley mentions the occurrence of four specimens, at Stratford, Conn., two of which were killed. My friend, Dr. Wm. H. Hotchkiss, of this city, tells me that he was informed, by William Beers, Esq., that two Swans were seen in Branford Harbor, during a severe gale, about the middle of March, 1876. I take it for granted that they were of this species, since there is no positive record of the occurrence of the Trumpeter Swan (*Cygnus buccinator*) within our limits. Mr. Grinnell also informs me that several Swans were seen near Milford, Conn., about the same time. Swans were once common in New England, during the migrations, as seen from Morton's remarks concerning them (in 1632): "And first of the Swanne, because she is the biggest of all the fowles of that Country. There are of them in Merrimack River, and in other parts of the Country, greate Store at the seasons of the yeare. The flesh is not much desired of the inhabitants, but the skinnes may be accompted a commodity, fitt for divers uses, both for fethers, and quiles."†

NOTE.—The Trumpeter Swan (*Cygnus buccinator* Richardson), may, and very probably does, sometimes occur within our limits. Dr. Wood, of East Windsor Hill, informs me that a hunter in his vicinity, who was perfectly familiar with this bird in the West, where they were common, once told him that he had heard the unmistakable note of the Trumpeter Swan, but did not see the bird. A short

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\* Am. Nat., vol ix, No. 10, p. 573, Oct., 1875

† Force's Historical Tracts, vol. ii, Tract 5, p. 46.

time afterwards, however, on again meeting the Doctor, the hunter said that, a few days before, he heard the Swans coming and rushed into the house for his gun, but before he returned with it they had passed over, between the house and barn, that he had a good sight at them and was confident that they were Trumpeters. Proof is wanting to show that some of the birds mentioned under the last species were not really *Cygnus buccinator*.

230. *Anser hyperboreus* Pallas. Snow Goose.

A rare winter visitor. Linsley records seven specimens from Stratford, Conn. Mr. W. W. Coe, of Portland, has a magnificent specimen of this species in his cabinet. It was killed on the coast near Saybrook, Conn., in the fall of 1875.

NOTE.—The Barnacle Goose (*Branta leucopsis* Boie), a rare accidental visitor to our coast, from Europe, is given by Linsley from Stonington, Conn., but on insufficient evidence. Stragglers have been taken from South Carolina to Hudson's Bay, and a fine specimen of this Goose was killed on Long Island, N. Y., in October, 1876 (recorded by Mr. Lawrence),\* hence it may occur as a rare accidental straggler.

231. *Branta bernicla* (Linné) Scop. Brant Goose; Black Brant.

A tolerably common spring and autumn migrant, sometimes remaining through the winter. Linsley said: "The Brant is common here [Stratford, Conn.] in winter" (p. 269). Captain Brooks writes me that they are "not common" at Faulkner's Island, where he has "only taken one." Mr. Grinnell informs me that two specimens of this species were killed off Stratford Light, Conn., last spring (1877). Mr. Osborne also saw three individuals near the mouth of the East Haven River, Conn., April 14th, 1876. Dr. Wood, of East Windsor Hill, Conn., has a fine specimen in his cabinet. It was shot on the Connecticut River, *above* Hartford, in the spring of 1876.

This species is first recorded from New England by Thomas Morton, who, in 1632, wrote: "There are Geese of three sorts, vize, brant Geese, which are pide, and white Geese which are bigger, and gray Geese, which are as big and bigger then the tame Geese of England, with black legges, black bills, heads and necks black, the flesh farre more excellent, then the Geese of England, wild or tame,

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\* Bull. Nutt. Ornith. Club, vol. ii, No. 1, p. 18, Jan., 1877.

yet the purity of the air is such, that the biggest is accompted but an indifferent meale for a couple of men. There is of them great abundance. I have had often 1000. before the mouth of my gunne. I never saw any in England for my part so fatt, as I have killed there in those parts, the fethers of them makes a bedd, softer than any down bed that I have lyen on: and is there a very good commodity, the fethers of the Geese that I have killed in a short time have paid for all the powther and shott, I have spent in a yeare, and I have fed my doggs with as fatt Geese there, as I have ever fed upon myself in England.”\*

**232. *Branta Canadensis* (Linné) Gray.      Canada Goose; Wild Goose.**

A winter resident, common during migrations; they arrive in November (Nov. 24, 1872, Sage), some remaining through April and sometimes even into May (May 22, 1864, Sage; May 10, 1877, C. H. M.). Linsley writes that “Hundreds of the common ‘Wild Geese’ winter at the mouth of the Housatonic, and so near my own dwelling that I often with my telescope present a distinct view of their *eyes* to my friends who call. Birds are said to be near enough to shoot when their eyes are visible to the sportsman. Many are killed here merely for sale by gunners, who frequently send them to New York.”† Capt. Brooks says that they occasionally stop about the islands off Guilford, Conn., and that he killed two last November. Mr. Grinnell tells me that generally a few still winter about the mouth of the Housatonic River, Conn., and that over two hundred remained there last winter (1876-7). They begin to go north (some passing nearly due east) during the latter part of March (from Mar. 24th on), and all through April large flocks may be seen and heard overhead. Many of these contain upwards of one hundred and fifty birds, and I should say that they average about seventy-five. They were particularly numerous last spring (1877), and scarcely a day passed during April but one or more flocks were seen.

**233a. *Branta Canadensis*, var. *Hutchinsii* (Rich.) Coes.      Hutchins’ Goose; Southern Goose.**

Not common. “Stratford,” Conn. (Linsley). Mr. Geo. Bird Grinnell tells me that the hunters about Milford, Conn., all make a distinction between the common or Canada Goose and the Southern

\* Force’s Historical Tracts, Tract 5, (vol. ii,) p. 46.

† Am. Jour. Sci. and Arts, vol. xlv, No. 2, p. 269, 1843.

Goose. That the latter does not arrive till after the Canada Geese have all come, and that they do not stay long, but pass southward—hence their name. They are also noticeably smaller than the Canada Goose.

**233. *Anas boschas* Linné      Mallard**

A rare migrant. Have notes of its occurrence here September 30th, October, and November 13th, 1875, and Mr. Grinnell saw it in October and November, 1876. Linsley gives it from Stratford. Capt. Brooks writes me from Faulkner's Island, Conn., that they are not abundant: "occasionally see a few with Black Ducks in the fall."

**234. *Anas obscura* Gmelin      Black Duck.**

A resident, but most abundant during the migrations. Capt. Brooks writes me that they "come in September and stay through the winter. Leave in May and June." Linsley said that they occasionally bred about Stratford, Conn. That their edible qualities were early appreciated is seen from the writings of Thomas Morton, who said (in 1632): "Ducks, there are of three kinds, pidge Ducks, gray Ducks, and black Ducks, in greates abundance: the most about my habitation were black Ducks: and it was a noted custome at my howse, to have every mans Duck upon a trencher, and then you will thinke a man was not hardly used, they are bigger boddied, then the tame Ducks of England: very fatt and dainty flesh. The common doggs fees were the gibletts, unlesse they were boyled now and than for to make broth."\*

**235. *Dafilea acuta* (Linné) Bonaparte.      Pintail; Sprigtail.**

A rather rare winter resident. Have seen but few specimens. Linsley found it at Stratford, Conn. Mr. Osborne saw one in March (23), 1877. Mr. J. N. Clark, of Saybrook, Conn., tells me that he does not consider it particularly rare; in fact that he thinks it is rather common in spring and fall in that vicinity—about the mouth of the Connecticut. Dr. Wood, of East Windsor Hill, has two specimens killed on the Connecticut River above Hartford, but they are extremely rare there.

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\* New English Canaan, p. 47. Reprinted in Peter Force's *Historical Tracts*, Tract 5.



236. *Chaulelasmus streperus* (Linné) Gray. Gadwall; Gray Duck.

It occurs during the migrations; not common. Captain Brooks tells me that they are "occasionally seen" about Faulkner's Island, Conn., "but are not plenty." Linsley writes: "Flocks of the Gray Duck were here as early as August last season [1842], and were among the best of ducks for the table."\*

237. *Mareca Americana* (Gmelin) Stephens. Widgeon; Baldpate.

Not particularly rare during the migrations; may winter. Taken at Stratford, Conn., by Linsley, and all along the coast by others, too numerous to mention. Dr. Wood has seen three specimens, one of which he shot, near East Windsor, Conn., but they are rare in this State so far inland. Dr. Coues states that "the Widgeon breeds in abundance in Northern Dakota and Montana along the banks of the streams and pools."† Thomas Morton found them in New England in 1632, for he writes: "Widggens there are, and abundance of other water foule, some such as I have seene, and such as I have not seene else where, before I came into those parts, which are little regarded."‡

238. *Querquedula Carolinensis* (Gmelin) Stephens. Green-winged Teal.

A common migrant. Have seen it in March. Taken by Linsley at Stratford, Conn. Concerning this and the following species Morton wrote, in 1632: "Teales, there are of two sorts greene winged, and blew winged: but a dainty bird, I have bin much delighted with a rost of these for a second course, I had plenty in the rivers and ponds about my howse."

239. *Querquedula discors* (Linné) Stephen. Blue-winged Teal.

A rather common migrant. Mr. Dayan secured a beautiful male of this species on Lake Whitney, September 25th, 1875. Arrives in August (Grinnell), remaining through October (Oct. 20, 1874, Sage).

240. *Spatula clypeata* (Linné) Boie. Shoveller; "Spoonbill-duck."

This splendid species is a rare migrant along our shores. Linsley "obtained two fine males" at Stratford, Conn. Mr. Grinnell informs

\* Am. Jour. of Sci. and Arts, vol. xlv, No. 2, p. 269, April, 1843.

† Birds of the Northwest, p. 564, 1874.

‡ Reprinted in Force's Historical Tracts. Tract 5, p. 47.

me that he took two or three specimens about October 8th, 1875, in the Sound near Milford, Conn., and that he does not consider them particularly rare at that season. Mr. W. W. Coe has an immature specimen taken at Saybrook, December 8th, 1874. Mr. Robert Morris, of this city, tells me that he has killed it late in *July* on the West Haven meadows, and has also seen it, about the same time, and early in August, on the Quinnipiac marshes.

241. *Aix sponsa* (Linné) Boie. Wood Duck; Summer Duck.

A tolerably common summer resident, breeding in holes in trees. Arrives in March (March 18, 1876, Osborne), frequenting fresh-water ponds and streams, and lays in May, remaining into October. Zaddock Thompson, speaking of its occurrence in Vermont, says, "The Wood Duck is one of the most beautiful birds seen in this State, and is one of the very few permanent residents here."\*

242. *Fuligula marila* (Linné) Stephens. Greater Scaup Duck; Broad-bill; Blue-bill.

A rather common winter resident. Taken at Stratford by Linsley. Captain Brooks informs me that they are "plenty at Guilford, Conn." In spring Mr. Thos. Osborne has taken it as late as May 17th, (1876).

243. *Fuligula affinis* Eyton. Lesser Scaup Duck; Blue-bill.

A common winter resident. Much prized for the table. Remains till the middle or latter part of May (May 17, Osborne). Dr. Wood, of East Windsor Hill, once killed it on the Connecticut river in his vicinity.

244. *Fuligula collaris* (Donovan) Bonaparte. Ring-necked Duck.

It is not common, but may winter. Linsley took it at Stratford, Conn. Mr. Geo. Bird Grinnell has secured several specimens of this bird, in early spring, on the Sound, in the vicinity of Milford, Conn.

245. *Fuligula ferina*, var. *Americana* (Eyton) Coues. Red-head; Pochard.

Rare. Linsley took it at Stratford. The Rev. J. H. Hand writes me that he has taken it at Westbrook, Conn., but it is rare there.

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\* History of Vermont, p. 109, 1842.

246. *Fuligula vallisneria* (Wilson) Stephens. Canvas-back Duck.

Rare. "Stratford," Conn., (Linsley). Mr. Robert Morris, of this city, saw one May 7th, 1876. I am also informed by Rev. J. H. Hand, that it occurs at Westbrook, Conn., where it is "very rare."

247. *Bucephala clangula* (Linné) Coues. Golden-eye; Whistler.

A common winter resident. Found on the Sound and on fresh-water ponds from November to April or May (April 16th). Captain Brooks writes, from Faulkner's Island, "only see them here in very cold winters."

248. *Bucephala islandica* (Gmelin) Baird. Barrow's Golden-eye.

A rare winter visitant from the North. I include this species on the strength of a most typical (male adult) specimen in the cabinet of Mr. John H. Sage, of Portland, Conn. It was purchased by him, November 14th, 1867, from a man who said it was killed on the Sound, and there seems to be no reason for doubting his statement, especially since it has been taken as far South as New York City.\* Mr. William Brewster records it from Massachusetts with the following remarks: "I obtained an adult female in the flesh from Cape Cod, December 7th, 1871, which was pronounced by Prof. Baird unquestionably *B. Islandica*. Since then I have seen numbers of females and two fine adult males in the Boston Markets, most of them shot within State limits."†

249. *Bucephala albeola* (Linné) Baird. Butter-ball; Buffle-head.

A common winter resident. Found both on fresh and salt water. Nov., April 15th.

250. *Harelda glacialis* (Linné) Leach. Long-tailed Duck; Old Wife; Old Squaw.

A common winter resident; particularly abundant during the migrations. Captain Brooks writes me that they "usually come in October and leave in April or May." This is by far the most abundant species of duck found along our coast, and during the migrations (notably in November) hundreds of thousands of them can be seen on the Sound, covering the water as far as the eye can reach in every direction, and almost deafening one by their constant, and, to my ears, not altogether unpleasant, cackle. They are continually on the

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\* Coues' Birds of New England, p. 52 (300), 1868.

† Am. Nat., vol. vi, No. 5, pp. 306-7, May, 1872.

move and, notwithstanding their immense numbers, it is no easy task to approach within gunshot of the flock. Though as strictly maritime as any of our ducks, they have occasionally strayed so far into the interior as Central Ohio (Wheaton). Mr. Grinnell tells me that they occasionally breed here, but these may be wounded birds—"pensioners" as they are commonly called. Dr. Wood has taken it on the Connecticut River above Hartford, but it is rare there.

**251. *Camptolæmus Labradorius* (Gmelin) Gray.      Labrador Duck; ' Pied-Duck.**

A very rare winter visitor. Linsley took it at Stratford, Conn. Pennant, in his *Arctic Zoölogy*, says that this species was "sent from *Connecticut* to Mrs. Blackburn,\* in England."

**252. *Somateria mollissima* (Linné) Leach.      Eider Duck.**

A rare winter visitant along our coast. Linsley states that "one or two Eider Ducks were killed" at Stratford, Conn., by Mr. Lucius Curtis. Mr. Grinnell tells me, that he saw a specimen killed on the Sound, near Milford, Conn., by a gunner (Samuel Brown by name) May 29th, 1877, and that two Eider Ducks, *probably* of this species, were shot there in the fall of 1874.

**253. *Somateria spectabilis* (Linné) Boie.      King Eider.**

A rare winter visitor, like the last, and also taken at Stratford, Conn., by Linsley, who says of it: "I have obtained here this season two specimens of the King Duck, said never to have been seen here before. They are among the best for the table."† Giraud also states that "an adult male in perfect plumage was shot on Long Island Sound, in the winter of 1839."‡

**254. *Ædemia Americana* (Wilson) Swainson.      Black Scoter; Gray Coot.**

A tolerably common winter resident, but less so than either of the following. Linsley had it from Stratford. Have seen it early in October (October 4, 1876), and again in November, but the hunters regard it as rather rare. It sometimes visits the Great Lakes in winter, and Dr. Wheaton writes me that one was taken near Columbus, Ohio, in Dec. 1876.

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\* *Arctic Zoölogy*, vol. ii, p. 559, 1785.    † *Catal. Birds of Conn.*, p. 270, 1843.

‡ *Birds of Long Island*, p. 333, 1844.

255. *Edemia fusca* (Linné) Swainson. Velvet Scoter; White-winged Coot.

It is extremely abundant on the Sound during fall and spring, some remaining through the winter. Arrives about the first of October (Oct. 4, 1876) remaining till the middle of May (May 15, Osborne). Thousands of them visit the coast in October and November, to feed on the small shells (chiefly *Macra lateralis*) which the shallow muddy bottoms furnish in abundance. And in this connection it may be stated that the alimentary canals of the sea ducks afford the conchologist a rich collecting ground, often yielding unexpected treasures. This is the largest of our ducks, and like the other members of the genus, is generally considered unfit for the table, but when properly prepared and well cooked they are by no means bad eating. Though properly marine, it occurs on the Great Lakes in winter. Dr. Wood has taken two specimens on fresh water near East Windsor Hill, Conn.

256. *Edemia perspicillata* (Linné) Stephens. Surf Duck; Sea Coot; Scoter.

A common winter resident, being intermediate in numbers between the two foregoing—that is, it is neither abundant nor uncommon. Arrives late in September or early in October, remaining till the middle of April. Captain Brooks writes me that they are “common through fall, winter and spring” in the vicinity of Faulkner’s Island, Conn. I saw one on the Sound as late as June 29th (1877), and I am told that a few generally remain all summer, but they are probably “pensioners” (wounded birds) and do not breed.

257. *Erismatura rubida* (Wilson) Bonaparte. Ruddy Duck.

It is not rare during the migrations. Taken by Linsley at Stratford, Conn. Found both on fresh and salt water. Mr. J. N. Clark, of Saybrook, tells me that they are rather common about the mouth of the Connecticut, but that full plumaged birds are very rare. Dr. Crary tells me that one was shot on the Connecticut river, near Hartford, Conn., in October, 1858.

258. *Mergus merganser* Linné. Sheldrake; Merganser.

It is common during migrations; some probably wintering. Frequents fresh water lakes and rivers in the interior, and is “found occasionally about Guilford Harbor, Conn.” (Capt. Brooks), but is not

common on salt water. Remains into April (April 17, 1875, male adult shot, Sage).

259. *Mergus serrator* Linné. Red-breasted Merganser.

A common migrant, wintering on the Sound. Captain Brooks writes me that they are "plenty during winter and spring" about Faulkner's Island, Conn. Also found on fresh water. Remains into April (April 14, 1876, Osborne).

260. *Mergus cucullatus* Linné. Hooded Merganser.

A winter resident; not common. Linsley obtained two specimens from a fresh water pond near Stratford, Conn., and Captain Brooks has one, killed at Guilford, Conn., on salt water. Mr. W. W. Coe has taken it during the migrations, and I saw one in November, 1875. Dr. Wood has taken it near East Windsor, but finds it rarely. Mr. Sage writes me that one was killed near Middletown, Conn., March 6th, 1876.

Family, SULIDÆ.

261. *Sula bassana* Linné. Common Gannet; Solon Goose.

A rare winter visitant. Captain Brooks writes me from Faulkner's Island, that he has "only seen two specimens," one of which is now in his collection: "It was killed at Guilford, Conn., in the spring, about ten years ago." Linsley took it at Stratford, Conn., and, concerning its gastronomic proclivities, remarks: "The true Solon Goose killed here, which I presented to the Yale Natural History Society, had in its stomach a bird, and in the stomach of the latter was also a bird—destruction on destruction. Mr. B. Silliman, Jr., and Dr. Whelpley, who opened the stomach, observed this fact, as the former gentleman informed me. It was previously supposed this bird lived wholly on fishes."\* Giraud saw a few specimens, killed about Long Island and in the vicinity of New York City.† Mr. Robert Morris tells me that he saw an adult specimen, shot off Branford late in the fall of 1872 or 1873. There is also, in a restaurant in New Haven, a mounted example of the young of the Solon Goose, killed near here a few years ago.

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\* Am. Jour. Sci. and Arts, vol. xliv, No. 2, p. 271, April, 1843.

† Giraud's Birds of Long Island, p. 345, 1844.

262. *Sula fiber* Linné. Booby Gannet.

A rare or accidental visitor from the South. Linsley took it at Guilford, Conn. It has been taken as far north as Massachusetts (in September).\*

## Family, PHALACROCORACIDÆ.

263. *Graculus carbo* (Linné) Gray. Common Cormorant; Shag.

A tolerably common winter visitant. Captain Brooks writes me that they are "plenty in April and May" and are sometimes seen in fall. Linsley took it at Stonington, Conn.

264. *Graculus dilophus* (Swainson) Gray. Double-crested Cormorant.

It occurs along the coast during fall and spring, but usually not in very large numbers, though Captain Brooks informs me that he "saw large flocks of them feeding about Faulkner's Island, Conn., in the month of May, 1876," and that he captured two of them. Linsley had a specimen from Stratford, Conn., and he regarded it as a very rare bird. Mr. W. W. Coe has a specimen in his cabinet which he killed on the Connecticut River, near Middletown, October 29th, 1875. While out duck-hunting at the mouth of the East Haven River, November 13th, 1875, with Mr. Thomas Osborne, we saw a Cormorant which I judged to be of this species. In speaking of the Cormorants, in New England, in 1675, Josselyn observes: "Though I cannot commend them to our curious palats, the *Indians* will eat them when they are fley'd, they take them prettily, they roost in the night upon some Rock that lyes out in the Sea, thither the *Indian* goes in his Birch-*Canow* when the moon shines clear, and when he is come almost to it, he lets his *Canow* drive on of it self, when he is come under the Rock he shoves his boat along till he come just under the *Cormorants* watchman, the rest being asleep, and so soundly do sleep that they will snore like so many Pigs; the *Indian* thrusts up his hand of a sudden, grasping the watchman so hard round about his neck that he cannot cry out; as soon as he hath him in his *Canow* he wrings off his head, and making his *Canow* fast, he clam-breth to the top of the Rock, where walking softly he takes them up as he pleaseth, still wringing off their heads; when he hath slain as many as his *Canow* can carry, he gives a shout which awaketh the surviving *Cormorants*, who are gone in an instant."†

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\* Putnam, in *Proceed. Essex Inst.*, vol. i, p. 221, 1856.

† Josselyn's *Two Voyages to New England*, p. 102, 1675.

## Family, TACHYPETIDÆ.

265. *Tachypetes aquilus* (Linné) Vieillot. Frigate Pelican; Man-of-war Bird.

An extremely rare accidental visitor from the South. But one instance of its occurrence in New England has been recorded, and that was published in the *Naturalist*, by Mr. Grinnell, nearly two years ago: "The occurrence of *Tachypetes aquilus* in Connecticut is not generally known, Long Island being, up to this time, the northernmost locality on record for this bird. A female of this species was killed at Faulkner's Island in this State, in the autumn of 1859, and is now in the collection of Captain Brooks. It was hovering over the island when shot."\* I have seen this specimen in Capt. Brooks's Cabinet.

## Family, LARIDÆ.

266. *Stercorarius parasiticus* (Brünn.) Schæff. Richardson's Jaeger.

A rare winter visitor. Linsley gave it from Bridgeport, Conn. I have lately seen a specimen in the cabinet of Mr. John H. Sage, of Portland, Conn., which was killed at that place in the fall of 1875.

267. *Stercorarius Buffoni* (Boie) Coues. Long-tailed Jaeger.

A rare straggler from the far North. Not previously recorded from Connecticut. I have just received, from Mr. Wm. F. Lane, a beautiful adult specimen of this Larine plunderer, which he shot on the Community Lake at Wallingford, Conn., August 30th, 1873. Mr. Lane writes me that he was out sailing on the lake, with his brother, when they noticed a curious bird, unlike any they had ever before seen. "It was chasing a swallow, which it soon caught, and then lit on the water with the swallow in its mouth, and commenced swimming around and did not seem to be very wild." Mr. Lane then went ashore for his gun, and, on returning, sailed so close to the bird that his brother was obliged to splash the water with an oar in order to make it fly, and as it rose he shot it. He says: "The bird was alone and had been flying around the lake for about an hour when I shot it. I noticed that it was very swift on the wing, also a very fast swimmer. It did not seem at all afraid of anyone."

NOTE.—The Pomarine Jaeger, *Stercorarius pomatorhinus* (Temminck) Vieillot, doubtless occurs as a rare winter visitant.

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\* Am. Nat., vol. ix, No. 8, p. 470, Aug., 1875.



268. *Larus marinus* Linné. Great Black-backed Gull.

A winter resident; not rare. Linsley records it from Stratford, Conn. During January, February and March, one frequently sees two or three *Larus marinus* flying about the Harbor in company with the common Herring Gulls.

269. *Larus argentatus*, var. *Smithsonianus* Coues. Herring Gull.

An abundant winter resident. Arrives from the North in October, remaining till April or May. Have seen hundreds of them together in New Haven Harbor in February and March. Mr. Thomas B. Osborne has seen them in June and early September, and a few doubtless spend the summer, but they are probably young birds and do not breed. Dr. Wood occasionally finds it about the Connecticut River above Hartford. On June 29th, 1877, I saw five together near Faulkner's Island, Conn. Four of these were in the young (gray) plumage, while one was white.

270. *Larus Delawareensis* Ord. Ring-billed Gull.

Not rare. Linsley found it at Stonington, Conn. The young of this species, easily recognized by having "a broad, subterminal band of black" across the tail (Coues), may frequently be seen in winter associated with the foregoing. My attention was first called to it by Mr. E. P. Bicknell, of Riverdale, N. Y.

271. *Larus tridactylus* Linné. Kittiwake Gull.

Occurs in winter, but is not common. Linsley gave it from Stonington, Conn. Mr. Osborne has seen it from March 8th till April 14th.

272. *Larus atricilla* Linné. Laughing Gull.

Not common. Possibly a few breed on some of the islands off our coast. Linsley states that they were occasionally killed at Stonington, Conn. Mr. Osborne informs me that he saw one June 1st, 1876.

273. *Larus Philadelphia* (Ord) Gray. Bonaparte's Gull.

Is tolerably common in fall. Captain Brooks writes me that they are "quite common about Faulkner's Island, Conn., in October and November," and that he occasionally sees them "with Terns at Goose Island, Conn., in summer." Linsley states that he "obtained an

individual of this beautiful species of gull, August 1st, 1842." (p. 271.) I saw the remains of one that had been killed in November, 1875, near New Haven. Specimens of it are also in the collections of W. W. Coe and J. H. Sage of Portland, Conn., and Mr. Wm. F. Lane sends me a specimen from Wallingford, Conn., stating that eight were seen there in the fall of 1874.

NOTE.—The Burgomaster (*Larus glaucus* Brünnich) may sometimes occur along our coast as a rare winter visitant from the North, but I have, as yet, been unable to procure satisfactory evidence of its presence within our limits, although it has been taken on Long Island.

274. *Sterna hirundo* Auct. Common Tern; Wilson's Tern; Sea Swallow.

A common summer resident along the coast. Captain Brooks informs me that they breed at Goose Island, Conn., but not so abundantly as the Roseate.

275. *Sterna macroura* Naumann. Arctic Tern.

A rare visitor to our shores. Mr. J. N. Clark, of Saybrook, Conn., writes me: "I have an undoubted specimen, in the fall plumage of the young (as described by Coues), taken here last season—never captured a mature bird."

276. *Sterna Dougalli* Mont. (*S. paradisea* of Authors.)\* Roseate Tern.

An abundant summer resident. Captain Brooks writes me that they first "make their appearance about the middle of May, and commence laying about the first of June, at Goose Island (one mile west of Faulkner's Island, Conn.), where they breed in great quantities, if not disturbed." Through the kindness of Captain Brooks I have recently (June 29, 1877) visited Goose Island, and have thus been permitted to witness the magnificent aerial evolutions of these beautiful birds, as hundreds of them swept to and fro over our heads, constantly uttering their characteristic cries. They would rise high in the air and immediately dive to the water's edge, then, suddenly turning, would sweep over the island and settle on the large rocks with which it is bordered, always, as the Captain remarked, "keeping their heads to the wind'ard." It is truly a splendid sight, and one well worth going many miles to see. As they cover the rocks, almost

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\* See Coues' Birds of the Northwest, p. 688 1874.

hiding them from view, their jet-black caps and pearly mantles contrast nicely with the pure white under parts and bright red legs. The eggs were now hatching and thousands of downy young covered the island. I actually caught an adult female entangled in the weeds, among which their eggs are deposited with little attempt at a nest. Where the weeds were particularly thick, forming dense mats, the eggs were sometimes placed *upon*, as well as under, them; we found several such. Great credit is due Captain Brooks for his watchfulness over this little colony: but for him they would long since have been exterminated.

277. *Sterna superciliaris*, var. *Antillarum* Coues. Least Tern.

Not very common. Linsley took it at Stratford, Conn. Mr. J. N. Clark, of Saybrook, Conn., tells me that they are sometimes quite abundant there during the migrations.

278. *Sterna fuliginosa* Gmelin. Sooty Tern.

A rare visitor from the South. The claim of this species to a place among the birds of New England has only recently been established, the only authentic instances of its capture having been published within a year. In a late number of the "Bulletin," Mr. H. A. Purdie says that Mr. J. N. Clark has a specimen in his collection "that last summer flew against the side of the steamboat wharf depot, at Saybrook, Conn. Stunned by the concussion it fell and was picked up. It had been noticed for several days, flying about the mouth of the river, as something unusual."\* Professor Sanborn Tenney states that a specimen was killed as far inland as the northwestern corner of Massachusetts ("near the Hoosac river") in September, 1876.† These two are, so far as I am aware, the only recorded instances of its capture in New England. Mr. Frederick T. Jencks, of Providence, R. I., writes me that he took a particularly beautiful specimen at Point Judith, R. I., last fall. Through the kindness of several friends I am enabled to add five Connecticut examples to those given above, thus increasing the total number ascertained to have occurred in New England to eight, six of which were killed in this State. Four of these I have myself seen. The circumstances connected with the capture of these specimens are as follows: Two adult birds killed themselves, last September (1876), by flying against the lighthouse

\* Bull. Nat. Ornith. Club, vol. ii, No. 1, p. 22, Jan., 1877.

† Am. Nat., vol. xi, No. 4, p. 243, April, 1877.

tower at Faulkner's Island. One of them is now in the collection of Captain O. N. Brooks, of that place; Mr. Elbert Coe, of Stony Creek, Conn., has a mounted specimen which was killed there with a stone, late in the summer (1876); Mr. Norman Elmore, of Granby, Conn., has just sent me, for examination, a bird of this species that was taken in that vicinity, September 20th, 1876. The Rev. J. Howard Hand writes me that it was procured in a singular place and manner: "It was knocked down with a stick by a gentleman who was netting wild pigeons. He first saw it, I think, on the pigeon poles. He got it alive, but of course could not get it to eat, and after keeping it two or three days it died." This and the one killed by Elbert Coe, Esq., are both in the young-of-the-year plumage, as described by Coes.\* It is a singular fact that all these specimens were killed last fall, and probably all in September.

**279. *Hydrochelidon lariformis* (Linné) Coes.**      Black Tern; Short-tailed Tern.

A rare visitor, occurring chiefly in fall. Though essentially an inland species, it is sometimes found along the coast during migrations. Captain Brooks took one specimen near Goose Island, Conn., about twelve years ago—the only one he has ever seen. Mr. George Bird Grinnell informs me that his brother shot a bird of this species, late in August, near Milford, Conn.

NOTE.—Several species of Terns, not mentioned above, doubtless occur within our limits. *Sterna anglica* (*aranea* of Wilson), *S. cautiaca* (*aruffurida* of Cabot), *S. caspia* and *S. regina* are to be looked for as rare visitors from the South, while *S. Forsteri* probably occurs occasionally in fall, and *Xema Sabini* may be met with as a rare straggler from the North.

### Family, PROCELLARIIDÆ.

**280. *Cymochorea leucorrhoa* (Vieillot) Coes.**      Leach's Petrel.

Tolerably common off the coast in summer, but is more frequently seen outside than in the Sound. I am informed by Captain Brooks that it is "occasionally seen during the summer months cruising in the vicinity of Faulkner's Island." Dr. Crary, of Hartford, Conn.,

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\* Birds of the Northwest, p. 699, 1874.

informs me that one was shot, October 27th, 1857, by George Meigs, on the Connecticut River, above Hartford. Since writing the above I have twice seen it, on the Sound, in the vicinity of Faulkner's Island, and near New Haven. I am inclined to believe that a few breed on some of the islands off our coast.

**281. *Oceanites oceanica* (Kuhl.) Coues.      Wilson's Petrel.**

Not common; occurs off the coast in summer. Linsley says that he has seen this species "not only in our Sound, but even west of Stratford, and sitting quietly upon the water," and further states that he once caught a specimen "at sea, by floating about two hundred feet of thread in the air, against which it flew, and thus became entangled and taken."\*

**282. *Puffinus major* Faber.      Greater Shearwater.**

Not rare in winter off the coast, but generally keeps outside the Sound. Linsley found it common about Stonington in the southeast corner of the State. In the Museum of Wesleyan University, at Middletown, is the head of a bird of this species which is said to have been killed at Granby, Conn.

**Family, COLYMBIDÆ.**

**283. *Colymbus torquatus* Brunn.      Loon; Great Northern Diver.**

A tolerably common winter resident. Arrives from the North in October, remaining till April or May (April 29, 1876, Osborne). I have a beautiful specimen killed at Branford, Conn., April 23d, 1875, and presented to me by Dr. Wm. H. Hotchkiss. It has been known to breed on a pond at Easthampton, Conn. (W. G. Buell).

**284. *Colymbus septentrionalis* Linné.      Red-throated Diver.**

A common winter resident. Arrives from the North in October, remaining till May, and Mr. Nichols informs me that he saw one as late as June 2d (1877). Frequently killed by gunners while duck-shooting on the Sound, but, as Captain Brooks writes, "you seldom get one with the red throat."

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\* Am. Jour. Sci. Arts, vol. xlv, No. 2, . 272, April, 1843.

NOTE.—*Colymbus Arcticus* may possibly occur as an extremely rare winter visitor from the far north, but I am unable, as yet, to find sufficient evidence of its capture within our limits, although there is a specimen so labelled in the Museum at Middletown. I cannot believe this to be anything more than an immature *Colymbus septentrionalis*, with the throat tinged with black.

### Family, PODICIPIDÆ.

#### 285. *Podiceps cristatus* (Linné) Latham. Crested Grebe.

Tolerably common during the migrations and in winter. Recorded by Linsley from Stratford, Conn. W. W. Coe and J. H. Sage have each specimens of this species taken here in winter. Dr. Wood, of East Windsor Hill, tells me that he has had but four specimens from that locality, and that they were all caught by hand in winter; having alighted in the snow they were unable to rise.

#### 286. *Podiceps griseigena*, var. *Holbolli* (Reinh.) Coues. Red-necked Grebe.

A rather rare winter resident. Captain Brooks says he has not seen one for years. Occurs both on fresh and salt water. Linsley took it at Stratford. Mr. J. H. Sage has a specimen which he took at Saybrook, Conn., February 23d, 1875. Dr. Wood has a very handsome specimen, in full plumage, shot near East Windsor some years ago. I am informed by Dr. Crary, of Hartford, Conn., that one was shot in that vicinity, by Jerry Crocker, October 19th, 1860.

#### 287. *Podiceps cornutus* Latham. Horned Grebe.

A common winter resident. Found on the coast as well as on lakes and ponds in the interior. Arrives in September or October, remaining till May.

#### 288. *Podilymbus podiceps* (Linné) Lawrence. Pied-billed Dabchick; Hell Diver.

A summer resident; common during the migrations. Found chiefly on fresh water, but is not rare on the Sound. Arrives from the North in September, remaining into November (and a few may winter). Mr. Geo. Bird Grinnell tells me that it breeds within the State.

Family, *ALCIDÆ*.289. *Utamania torda* (Linné) Leach.      Razor-billed Auk.

A rare winter visitor in the Sound.

290. *Mergulus alle* (Linné) Vieillot      Sea Dove; Dovekie.

A rare winter visitor on our coast. Prof. G. Brown Goode published the first authentic record of the capture of this species within the limits of the State. He states that, at Middletown, during a severe northeast storm, about the middle of November, 1871, "two individuals were captured in full winter plumage, and plump, though with empty stomachs. Their occurrence thirty miles inland is somewhat remarkable. Allen records the capture of a single specimen at Greenfield, Mass., on the Connecticut, and Linsley places the species among the birds of Connecticut on the strength of one captured near Martha's Vineyard,"\* Mass. Several others were secured at Middletown, by W. W. Coe and J. H. Sage, during this same storm during which Mr. Goode's were taken, and Mr. Sage has still another, captured there November 25th, 1874, in a gale. One was taken at Saybrook at the same time. Dr. Wood, of East Windsor Hill, showed me a specimen of this species, shot near Portland, Conn., November 10th, 1849. Two other individuals were killed on a pond at Wallingford, Conn., in September, 1874, by Wm. F. Lane, Esq. It is occasionally taken as far south as Egg Harbor, New Jersey.†

291. *Lomvia troile* (Linné) Brandt.      Foolish Guillemot, Murre.

A rare winter visitant in the Sound, though common enough outside. Captain Brooks took one near Faulkner's Island, Conn., "about eight years ago."

NOTE.—The Great Auk (*Alca impennis* Linné), supposed now to be extinct, was formerly, without doubt, a winter visitor to our coast. Aside from the three species of *Alcidæ* given above, as occurring within our limits, several others have been found still farther south and may be looked for in winter off Stonington, Conn., and perhaps even in the Sound. These are: *Fratercula Arctica*, *Uria grylle*, and *Lomvia arra*.

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\* Am Nat., vol. vi, No. 1, p. 49, Jan 1872.

† Birds of East Penn. and New Jersey. By Wm P. Turnbull, p 48, 1869.

B. *List of the Families of Birds now found in the State of Connecticut, with the number of their representative species.*

	Species.		Species.		
1	Turdidæ, -----	8	25	Picidæ, -----	8
2	Saxicolidæ, -----	1	26	Strigidæ, -----	11
3	Sylviidæ, -----	3	27	Falconidæ, -----	15
4	Paridæ, -----	3	28	Cathartidæ, -----	1
5	Sittidæ, -----	2	29	Columbidæ, -----	2
6	Certhiidæ, -----	1	30	Tetraonidæ, -----	2
7	Troglodytidæ, -----	4	31	Charadriidæ, -----	6
8	Alaudidæ, -----	1	32	Hæmatopodidæ, -----	2
9	Motacillidæ, -----	1	33	Recurvirostridæ, -----	1
10	Sylvicolidæ, -----	34	34	Phalaropodidæ, -----	2
11	Tanagridæ, -----	2	35	Scolopacidæ, -----	24
12	Hirundinidæ, -----	6	36	Tantalidæ, -----	2
13	Ampelidæ, -----	2	37	Ardeidæ, -----	8
14	Vireonidæ, -----	5	38	Rallidæ, -----	9
15	Laniidæ, -----	2	39	Anatidæ, -----	32
16	Fringillidæ, -----	32	40	Sulidæ, -----	2
17	Icteridæ, -----	8	41	Phalacrocoracidæ, -----	2
18	Corvidæ, -----	3	42	Tachypetidæ, -----	1
19	Tyrannidæ, -----	10	43	Laridæ, -----	14
20	Caprimulgidæ, -----	2	44	Procellariidæ, -----	3
21	Cypselidæ, -----	1	45	Colymbidæ, -----	2
22	Trochilidæ, -----	1	46	Podicipidæ, -----	4
23	Alcedinidæ, -----	1	47	Alcidæ, -----	3
24	Cuculidæ, -----	2			

C. *Special Lists, giving, in tabular form, the residents, summer and winter visitors, migrants, etc.*

(A.) SUMMER RESIDENTS.

1. *Species known to breed.*

1	Turdus migratorius.	21	Dendroeca cærulescens.*
2	Turdus mustelinus.	22	Dendroeca Blackburnia.*
3	Turdus fuscescens.	23	Dendroeca Pennsylvanica.
4	Mimus Carolinensis.	24	Dendroeca discolor.
5	Harporhynchus rufus.	25	Dendroeca pinus.
6	Sialia sialis.	26	Siurus auricapillus.
7	Parus atricapillus.	27	Siurus motacilla.
8	Sitta Carolinensis.	28	Geothlypis trichas.
9	Certhia familiaris.	29	Icteria virens.
10	Troglodytes ædon.	30	Myiodioctes mitratus.
11	Telmatodytes palustris.	31	Myiodioctes Canadensis.*
12	Cistothorus stellaris.*	32	Setophaga ruticilla.
13	Mniotilta varia.	33	Pyrranga rubra.
14	Parula Americana.	34	Hirundo horreorum.
15	Helminthorus vermivorus.	35	Tachycineta bicolor.
16	Helminthophaga pinus.	36	Petrochelidon lunifrons.
17	Helminthophaga chrysoptera.*	37	Cotyle riparia.
18	Helminthophaga ruficapilla.	38	Progne purpurea.
19	Dendroeca æstiva.	39	Ampelis cedrorum.
20	Dendroeca virens.*	40	Vireo olivaceus.

\* An asterisk placed after a species indicates that it does not breed abundantly.



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|---------------------------------|-------------------------------------|
| 41 Vireo gilvus.                | 89 Bubo Virginianus.                |
| 42 Vireo flavifrons.*           | 90 Scops asio.                      |
| 43 Vireo solitarius.            | 91 Otus vulgaris, var. Wilsonianus. |
| 44 Vireo noveboracensis.        | 92 Brachyotus palustris.            |
| 45 Carpodacus purpureus.        | 93 Syrniun nebulosum.               |
| 46 Chrysomitris tristis.        | 94 Nyctale Acadica.                 |
| 47 Passerculus Savanna.         | 95 Circus cyaneus, var. Hudsonius.  |
| 48 Poocetes gramineus.          | 96 Accipiter fuscus.                |
| 49 Coturniculus passerinus.     | 97 Accipiter Cooperi.               |
| 50 Coturniculus Henslowi.*      | 98 Falco communis.*                 |
| 51 Ammodromus maritimus.        | 99 Falco sparverius.*               |
| 52 Ammodromus caudacutus.       | 100 Buteo borealis.                 |
| 53 Melospiza palustris.         | 101 Buteo lineatus.                 |
| 54 Melospiza melodia.           | 102 Buteo Pennsylvanicus.           |
| 55 Melospiza Lincolni.*         | 103 Pandion haliaetus.              |
| 56 Spizella socialis.           | 104 Haliaetus leucocephalus.*       |
| 57 Spizella pusilla.            | 105 Ectopistes migratorius.         |
| 58 Passer domesticus.           | 106 Zenaidura Carolinensis.         |
| 59 Euspiza Americana.*          | 107 Bonasa umbellus.                |
| 60 Goniaphea Ludoviciana.       | 108 Ortyx Virginianus.              |
| 61 Cyanospiza cyanea.           | 109 Ægialitis vocifera.             |
| 62 Pipilo erythrophthalmus.     | 110 Ægialitis meloda.               |
| 63 Dolichonyx oryzivorus.       | 111 Philohela minor.                |
| 64 Molothrus pecoris.           | 112 Gallinago Wilsoni.*             |
| 65 Agelæus phœniceus.           | 113 Totanus semipalmatus.*          |
| 66 Sturnella magna.             | 114 Ereunetes pusillus.*            |
| 67 Icterus spurius.             | 115 Tringoides macularius.          |
| 68 Icterus Baltimore.           | 116 Actiturus Bartramius.           |
| 69 Quiscalus purpureus.         | 117 Ardea herodias.*                |
| 70 Corvus Americanus.           | 118 Ardea virescens.                |
| 71 Cyanurus cristatus.          | 119 Nyctiardea grisea, var. nævia.  |
| 72 Tyrannus Carolinensis.       | 120 Botaurus minor.                 |
| 73 Myiarchus crinitus.          | 121 Ardetta exilis.                 |
| 74 Sayornis fuscus.             | 122 Rallus longirostris.            |
| 75 Contopus virens.             | 123 Rallus elegans.                 |
| 76 Empidonax Traillii.          | 124 Rallus Virginianus.             |
| 77 Empidonax minimus.           | 125 Porzana Carolina.               |
| 78 Antrostomus vociferus.       | 126 Porzana noveboracensis.*        |
| 79 Chordeiles Virginianus.      | 127 Porzana Jamaicensis.*           |
| 80 Chætura pelagica.            | 128 Gallinula galeata.              |
| 81 Trochilus colubris.          | 129 Anas obscura.                   |
| 82 Ceryle alcyon.               | 130 Aix sponsa.                     |
| 83 Coccyzus erythrophthalmus.   | 131 Harelda glacialis.*             |
| 84 Coccyzus Americanus.         | 132 Sterna hirundo.                 |
| 85 Picus villosus.              | 133 Sterna Dougalli.                |
| 86 Picus pubescens.             | 134 Colymbus torquatus.*            |
| 87 Melanerpes erythrocephalus.* | 135 Podilymbus podiceps.            |
| 88 Colaptes auratus.            |                                     |

2. *Species which probably breed occasionally, but are not known to do so.*

- |                                |                                          |
|--------------------------------|------------------------------------------|
| 1 Mimus polyglottus.           | 12 Contopus borealis.                    |
| 2 Polioptila cerulea.          | 13 Empidonax Acadicus.                   |
| 3 Lophophanes bicolor.         | 14 Sphyrapicus varius.                   |
| 4 Thyrothorus Ludovicianus.    | 15 Centurus Carolinus.                   |
| 5 Dendroeca cerulea.           | 16 Strix flammea, var. Americana.        |
| 6 Dendroeca Dominica.          | 17 Falco columbarius.                    |
| 7 Siurus nævius.               | 18 Ægialitis Wilsonia.                   |
| 8 Oporornis formosus.          | 19 Totanus solitarius.                   |
| 9 Pyrranga æstiva.             | 20 Sterna superciliosa, var. Antillarum. |
| 10 Stelgidopteryx serripennis. | 21 Cymochorea leucorrhœa.                |
| 11 Cardinalis Virginianus.     |                                          |

## (B.) RESIDENT SPECIES.

- |    |                                     |    |                                                       |
|----|-------------------------------------|----|-------------------------------------------------------|
| 1  | <i>Turdus migratorius</i> .         | 22 | <i>Bubo Virginianus</i> .*                            |
| 2  | <i>Sialia sialis</i> .              | 23 | <i>Scops asio</i> .*                                  |
| 3  | <i>Parus atricapillus</i> .*        | 24 | <i>Otus vulgaris</i> , var. <i>Wilsonianus</i> .*     |
| 4  | <i>Sitta Carolinensis</i> .*        | 25 | <i>Brachyotus palustris</i> .*                        |
| 5  | <i>Certhia familiaris</i> .*        | 26 | <i>Syrnium nebulosum</i> .*                           |
| 6  | <i>Ampelis cedrorum</i> .           | 27 | <i>Nyctale Acadica</i> .*                             |
| 7  | <i>Carpodacus purpureus</i> .       | 28 | <i>Falco communis</i> .                               |
| 8  | <i>Chrysomitris tristis</i> .       | 29 | <i>Falco columbarius</i> .                            |
| 9  | <i>Melospiza melodia</i> .          | 30 | <i>Falco sparverius</i> .                             |
| 10 | <i>Spizella socialis</i> .          | 31 | <i>Buteo borealis</i> .                               |
| 11 | <i>Passer domesticus</i> .*         | 32 | <i>Buteo lineatus</i> .                               |
| 12 | <i>Molothrus pecoris</i> .          | 33 | <i>Buteo Pennsylvanicus</i> .                         |
| 13 | <i>Agelaius phoeniceus</i> .        | 34 | <i>Haliaeetus leucocephalus</i> .                     |
| 14 | <i>Sturnella magna</i> .            | 35 | <i>Zenaidura Carolinensis</i> .                       |
| 15 | <i>Corvus Americanus</i> .          | 36 | <i>Bonasa umbellus</i> .*                             |
| 16 | <i>Cyanurus cristatus</i> .*        | 37 | <i>Ortyx Virginianus</i> .*                           |
| 17 | <i>Ceryle alcyon</i> .              | 38 | <i>Philohela minor</i> .                              |
| 18 | <i>Picus villosus</i> .*            | 39 | <i>Anas obscura</i> .                                 |
| 19 | <i>Picus pubescens</i> .*           | 40 | <i>Harelda glacialis</i> .                            |
| 20 | <i>Melanerpes erythrocephalus</i> . | 41 | <i>Larus argentatus</i> , var. <i>Smithsonianus</i> . |
| 21 | <i>Colaptes auratus</i> .           |    |                                                       |

## (C.) MIGRANTS NOT KNOWN TO BREED.

(Some of these winter.)

- |                |                                                       |    |                                                     |
|----------------|-------------------------------------------------------|----|-----------------------------------------------------|
| 1              | <i>Turdus Pallasi</i> .                               | 28 | <i>Aquila chrysaetus</i> .                          |
| 2              | <i>Turdus Swainsoni</i> .                             | 29 | <i>Squatarola Helvetica</i> .                       |
| 2 <sup>a</sup> | <i>Turdus Swainsoni</i> , var. <i>Aliciae</i> .       | 30 | <i>Charadrius fulvus</i> , var. <i>Virginicus</i> . |
| 3              | <i>Regulus calendula</i> .                            | 31 | <i>Ægialitis semipalmata</i> .                      |
| 4              | <i>Regulus satrapa</i> .                              | 32 | <i>Hæmatopus palliatus</i> .                        |
| 5              | <i>Anorthura troglodytes</i> , var. <i>hyemalis</i> . | 33 | <i>Streptopelia interpres</i> .                     |
| 6              | <i>Anthus Ludovicianus</i> .                          | 34 | <i>Recurvirostra Americana</i> .                    |
| 7              | <i>Helminthophaga peregrina</i> .                     | 35 | <i>Phalaropus fulicarius</i> .                      |
| 8              | <i>Dendroeca coronata</i> .                           | 36 | <i>Macrorhamphus griseus</i> .                      |
| 9              | <i>Dendroeca striata</i> .                            | 37 | <i>Tringa minutilla</i> .                           |
| 10             | <i>Dendroeca castanea</i> .                           | 38 | <i>Tringa maculata</i> .                            |
| 11             | <i>Dendroeca maculosa</i> .                           | 39 | <i>Tringa fuscicollis</i> .                         |
| 12             | <i>Dendroeca tigrini</i> .                            | 40 | <i>Tringa maritima</i> .                            |
| 13             | <i>Dendroeca palmarum</i> .                           | 41 | <i>Tringa alpina</i> .                              |
| 14             | <i>Sturus naevius</i> .                               | 42 | <i>Tringa subarquata</i> .                          |
| 15             | <i>Oporornis agilis</i> .                             | 43 | <i>Tringa canutus</i> .                             |
| 16             | <i>Geothlypis Philadelphia</i> .                      | 44 | <i>Calidris arenaria</i> .                          |
| 17             | <i>Myiodioctes pusillus</i> .                         | 45 | <i>Limosa fedoa</i> .                               |
| 18             | <i>Passerculus princeps</i> .                         | 46 | <i>Limosa Hudsonica</i> .                           |
| 19             | <i>Junco hyemalis</i> .                               | 47 | <i>Totanus melanoleucus</i> .                       |
| 20             | <i>Spizella monticola</i> .                           | 48 | <i>Totanus flavipes</i> .                           |
| 21             | <i>Zonotrichia albicollis</i> .                       | 49 | <i>Totanus solitarius</i> .                         |
| 22             | <i>Zonotrichia leucophrys</i> .                       | 50 | <i>Tryngites rufescens</i> .                        |
| 23             | <i>Passerella iliaca</i> .                            | 51 | <i>Numenius longirostris</i> .                      |
| 24             | <i>Scolecophagus ferrugineus</i> .                    | 52 | <i>Numenius Hudsonicus</i> .                        |
| 25             | <i>Contopus borealis</i> .                            | 53 | <i>Numenius borealis</i> .                          |
| 26             | <i>Empidonax flaviventris</i> .                       | 54 | <i>Fulica Americana</i> .                           |
| 27             | <i>Sphyrapicus varius</i> .                           | 55 | <i>Anser hyperboreus</i> .                          |

\* Those marked with an asterisk are resident *individually*, while the others are represented here, in winter, by individuals which probably breed much farther north.

56 <i>Branta bernicla</i> .	73 <i>Oedemia Americana</i> .
57 <i>Branta Canadensis</i> .	74 <i>Oedemia fusca</i> .
57 <sup>a</sup> <i>Branta Canadensis</i> , var. <i>Hutchinsi</i> .	75 <i>Oedemia perspicillata</i> .
58 <i>Anas boschas</i> .	76 <i>Erismatura rubida</i> .
59 <i>Nafla acuta</i> .	77 <i>Mergus merganser</i> .
60 <i>Chaulelasmus streperus</i> .	78 <i>Mergus serrator</i> .
61 <i>Mareca Americana</i> .	79 <i>Mergus cucullatus</i> .
62 <i>Querquedula Carolinensis</i> .	80 <i>Graculus carbo</i> .
63 <i>Querquedula discors</i> .	81 <i>Graculus dilophus</i> .
64 <i>Spatula clypeata</i> .	82 <i>Larus tridactylus</i> .
65 <i>Fuligula marila</i> .	83 <i>Larus atricilla</i> .
66 <i>Fuligula affinis</i> .	84 <i>Larus Philadelphica</i> .
67 <i>Fuligula collaris</i> .	85 <i>Sterna macroura</i> .
68 <i>Fuligula ferina</i> , var. <i>Americana</i> .	86 <i>Sterna superciliiaris</i> , var. <i>Antillarum</i> .
69 <i>Fuligula vallisneria</i> .	87 <i>Hydrochelidon lariformis</i> .
70 <i>Bucephala clangula</i> .	88 <i>Colymbus septentrionalis</i> .
71 <i>Bucephala Islandica</i> .	89 <i>Podiceps cristatus</i> .
72 <i>Bucephala albeola</i> .	90 <i>Podiceps cornutus</i> .

## (D.) WINTER RESIDENTS, MORE OR LESS REGULAR.\*

1 <i>Regulus satrapa</i> .	19 <i>Fuligula marila</i> .
2 <i>Sitta Canadensis</i> .	20 <i>Fuligula affinis</i> .
3 <i>Anorthura troglodytes</i> , var. <i>hyemalis</i> .	21 <i>Bucephala clangula</i> .
4 <i>Eremophila alpestris</i> .	22 <i>Bucephala albeola</i> .
5 <i>Dendroeca coronata</i> .	23 <i>Harelda glacialis</i> .
6 <i>Collurio borealis</i> .	24 <i>Oedemia Americana</i> .
7 <i>Pinicola enucleator</i> .	25 <i>Oedemia fusca</i> .
8 <i>Plectrophanes nivalis</i> .	26 <i>Oedemia perspicillata</i> .
9 <i>Spizella monticola</i> .	27 <i>Mergus serrator</i> .
10 <i>Junco hyemalis</i> .	28 <i>Mergus cucullatus</i> .
11 <i>Zonotrichia albicollis</i> .	29 <i>Graculus carbo</i> .
12 <i>Nyctea Scandiac</i> .	30 <i>Larus marinus</i> .
13 <i>Astur atricapillus</i> .	31 <i>Larus argentatus</i> .
14 <i>Archibuteo lagopus</i> , var. <i>Sancti-Johannis</i> .	32 <i>Larus Delawarensis</i> .
15 <i>Tringa maritima</i> .	33 <i>Colymbus torquatus</i> .
16 <i>Branta bernicla</i> .	34 <i>Colymbus septentrionalis</i> .
17 <i>Branta Canadensis</i> .	35 <i>Podiceps cristatus</i> .
18 <i>Nafla acuta</i> .	36 <i>Podiceps cornutus</i> .

## (E.) WINTER VISITANTS, MORE OR LESS IRREGULAR.

1 <i>Lophophanes bicolor</i> .	17 <i>Cygnus Americanus</i> .
2 <i>Parus Hudsonicus</i> .	18 <i>Anser hyperboreus</i> .
3 <i>Ampelis garrulus</i> .	19 <i>Bucephala Islandica</i> .
4 <i>Loxia leucoptera</i> .	20 <i>Camptolemus Labradorius</i> .
5 <i>Loxia curvirostra</i> , var. <i>Americana</i> .	21 <i>Somateria mollissima</i> .
6 <i>Agriothus linaria</i> .	22 <i>Somateria spectabilis</i> .
7 <i>Chrysomitris pinus</i> .	23 <i>Sula bassana</i> .
8 <i>Plectrophanes Lapponicus</i> .	24 <i>Stercorarius parasiticus</i> .
9 <i>Passerculus princeps</i> .	25 <i>Stercorarius Buffoni</i> .
10 <i>Zonotrichia leucophrys</i> .	26 <i>Larus tridactylus</i> .
11 <i>Hylotomus pileatus</i> .	27 <i>Puffinus major</i> .
12 <i>Picoides Arcticus</i> .	28 <i>Podiceps griseigena</i> , var. <i>Holbolli</i> .
13 <i>Syrnium cinereum</i> .	29 <i>Utamania torda</i> .
14 <i>Surnia uhla</i> , var. <i>Hudsonia</i> .	30 <i>Mergulus alle</i> .
15 <i>Nyctale Tengmalmi</i> , var. <i>Richardsoni</i> .	31 <i>Lomvia troile</i> .
16 <i>Aquila chrysaetus</i> .	

\* This list does not include resident species.

## (F.) IRREGULAR SUMMER VISITANTS.

- |                                                   |                                                |
|---------------------------------------------------|------------------------------------------------|
| 1 <i>Mimus polyglottus</i> .                      | 16 <i>Cathartes aura</i> .                     |
| 2 <i>Poliophtila cærulea</i> .                    | 17 <i>Ægialitis Wilsonia</i> .                 |
| 3 <i>Lophophanes bicolor</i> .                    | 18 <i>Ibis falcinellus</i> , var. <i>Ordii</i> |
| 4 <i>Dendroeca cærulea</i> .                      | 19 <i>Ibis alba</i> .                          |
| 5 <i>Dendroeca Dominica</i> .                     | 20 <i>Ardea egretta</i> .                      |
| 6 <i>Oporornis formosus</i> .                     | 21 <i>Ardea candidissima</i> .                 |
| 7 <i>Pyrranga æstiva</i> .                        | 22 <i>Ardea cærulea</i> .                      |
| 8 <i>Stelgidopteryx serripennis</i> .             | 23 <i>Porzana Jamaicensis</i> .                |
| 9 <i>Euspiza Americana</i> .                      | 24 <i>Porphyrio Martinica</i> .                |
| 10 <i>Cardinalis Virginianus</i> .                | 25 <i>Sula fiber</i> .                         |
| 11 <i>Corvus ossifragus</i> .                     | 26 <i>Tachypetes aquilus</i> .                 |
| 12 <i>Milvulus forficatus</i> .                   | 27 <i>Sterna fuliginosa</i> .                  |
| 13 <i>Empidonax Acadicus</i> .                    | 28 <i>Hydrochelidon lariformis</i> .           |
| 14 <i>Centurus Carolinus</i> .                    | 29 <i>Cymochorea leucorrhoa</i> .              |
| 15 <i>Strix flammea</i> , var. <i>Americana</i> . | 30 <i>Oceanites oceanica</i> .                 |

## (G.) RARE ACCIDENTAL VISITORS.

- |                                                         |                                                  |
|---------------------------------------------------------|--------------------------------------------------|
| 1 <i>Mimus polyglottus</i> .                            | 24 <i>Phalaropus fulicarius</i> .                |
| 2 <i>Poliophtila cærulea</i> .                          | 25 <i>Limosa Hudsonica</i> .                     |
| 3 <i>Lophophanes bicolor</i> .                          | 26 <i>Ibis falcinellus</i> , var. <i>Ordii</i> . |
| 4 <i>Parus Hudsonicus</i> .                             | 27 <i>Ibis alba</i> .                            |
| 5 <i>Oporornis formosus</i> .                           | 28 <i>Ardea egretta</i> .                        |
| 6 <i>Pyrranga æstiva</i> .                              | 29 <i>Ardea candidissima</i> .                   |
| 7 <i>Stelgidopteryx serripennis</i> .                   | 30 <i>Ardea cærulea</i> .                        |
| 8 <i>Ampelis garrulus</i> .                             | 31 <i>Porzana Jamaicensis</i> .                  |
| 9 <i>Collurio Ludovicianus</i> .                        | 32 <i>Porphyrio Martinica</i> .                  |
| 10 <i>Euspiza Americana</i> .*                          | 33 <i>Cygnus Americanus</i> .                    |
| 11 <i>Cardinalis Virginianus</i> .                      | 34 <i>Bucephala Islandica</i> .                  |
| 12 <i>Corvus ossifragus</i> .                           | 35 <i>Camptolemus Labradorius</i> .              |
| 13 <i>Milvulus forficatus</i> .                         | 36 <i>Somateria mollissima</i> .                 |
| 14 <i>Hylotomus pileatus</i> .                          | 37 <i>Somateria spectabilis</i> .                |
| 15 <i>Picoides Arcticus</i> .                           | 38 <i>Sula bassana</i> .                         |
| 16 <i>Centurus Carolinus</i> .                          | 39 <i>Sula fiber</i> .                           |
| 17 <i>Strix flammea</i> , var. <i>Americana</i> .       | 40 <i>Tachypetes aquilus</i> .                   |
| 18 <i>Syrnium cinereum</i> .                            | 41 <i>Stercorarius parasiticus</i> .             |
| 19 <i>Surnia ulula</i> , var. <i>Hudsonia</i> .         | 42 <i>Stercorarius Buffoni</i> .                 |
| 20 <i>Nyctale Tengmalmi</i> , var. <i>Richardsoni</i> . | 43 <i>Sterna fuliginosa</i> .                    |
| 21 <i>Aquila chrysaetus</i> .                           | 44 <i>Utamania torda</i> .                       |
| 22 <i>Ægialitis Wilsonia</i> .                          | 45 <i>Mergus alle</i> .                          |
| 23 <i>Steganopus Wilsoni</i> .                          | 46 <i>Lomvia troile</i> .                        |

## (H.) RARE AND IRREGULAR MIGRANTS.

- |                                  |                                                     |
|----------------------------------|-----------------------------------------------------|
| 1 <i>Passerculus princeps</i> ?  | 11 <i>Anser hyperboreus</i> .                       |
| 2 <i>Ægialitis Wilsonia</i> .    | 12 <i>Anas boschas</i> .                            |
| 3 <i>Hematopus palliatus</i> .   | 13 <i>Chaulelasmus streperus</i> .                  |
| 4 <i>Steganopus Wilsoni</i> .    | 14 <i>Fuligula collaris</i> .                       |
| 5 <i>Phalaropus fulicarius</i> . | 15 <i>Fuligula ferina</i> , var. <i>Americana</i> . |
| 6 <i>Tringa subarquata</i> .     | 16 <i>Fuligula vallisneria</i> .                    |
| 7 <i>Limosa fedoa</i> .          | 17 <i>Bucephala Islandica</i> .                     |
| 8 <i>Limosa Hudsonica</i> .      | 18 <i>Sterna macroura</i> .                         |
| 9 <i>Numenius borealis</i> .     | 19 <i>Hydrochelidon lariformis</i> .                |
| 10 <i>Cygnus Americanus</i> .    |                                                     |

\* Although Linsley gives this species as "very common" at New Haven (in 1842), it has not since been met with, either by myself or any other collector in the State, so far as I am aware. Hence I am forced to regard its occurrence, at present, as purely accidental, and this without doubting Linsley's statement that it was once common. Indeed, I have recently seen two of Linsley's mounted specimens.

D. *An Analysis of Linsley's "Catalogue."*

In the year 1843, the Rev. James H. Linsley published, in the American Journal of Science and Arts, "A Catalogue of the Birds of Connecticut, arranged according to their natural families."\* In this Catalogue Mr. Linsley enumerates 302 species, this number including both those that had already been detected within our limits and those whose presence he thought likely (judging from their occurrence in contiguous States) future investigation might reveal. He likewise included the introduced and domesticated species—such as the California Quail, Pea Cock, Guinea Fowl, the various races of the domestic Pigeon (*Columba livia* Linné), and the common barn-yard fowl, numbering them with our native birds. Many species are given twice, and some even three times, the immature and seasonal plumages having been mistaken for distinct species. There are also a few doubtful forms, and at least two had been exterminated before his paper was written.† Hence it is that a critical examination of this list at once enables us to eliminate 63 species, thus reducing the total number from 302 to 239.‡

(A.) LIST OF THOSE SPECIES GIVEN BY LINSLEY IN HIS "Catalogue of the Birds of Connecticut," CONCERNING THE OCCURRENCE OF WHICH HE PROBABLY HAD SUFFICIENT PROOF.

1 Turdus migratorius.	31 Dendroeca coronata.
2 Turdus mustelinus.	32 Dendroeca Blackburniæ.
3 Turdus Pallasi.	33 Dendroeca striata.
4 Turdus fuscescens.	34 Dendroeca castanea.
5 Mimus polyglottus.	35 Dendroeca Pennsylvanica.
6 Mimus Carolinensis.	36 Dendroeca maculosa.
7 Harporhynchus rufus.	37 Dendroeca tigrina
8 Sialia sialis.	38 Dendroeca discolor.
9 Regulus calendula.	39 Dendroeca palmarum.
10 Regulus satrapa.	40 Dendroeca pinus.
11 Polioptila cærulea.	41 Siurus auricapillus.
12 Lophophanes bicolor.	42 Siurus naevius.
13 Parus atricapillus.	43 Geothlypis trichas.
14 Sitta Carolinensis.	44 Icteria virens.
15 Sitta Canadensis.	45 Myiodiotes mitratus.
16 Certhia familiaris.	46 Myiodiotes Canadensis.
17 Troglodytes ædon.	47 Setophaga ruticilla.
18 Anorthura troglodytes, var. hyemalis.	48 Pyrranga rubra.
19 Telmatodytes palustris.	49 Pyrranga æstiva.
20 Cistothorus stellaris.	50 Hirundo horreorum.
21 Eremophila alpestris.	51 Tachycineta bicolor.
22 Anthus Ludovicianus.	52 Cotyle riparia.
23 Mniotilta varia.	53 Progne purpurea.
24 Parula Americana.	54 Ampelis cedrorum.
25 Helminthophaga vermivorus.	55 Vireo olivaceus.
26 Helminthophaga ruficapilla.	56 Vireo gilvus.
27 Dendroeca æstiva.	57 Vireo flavifrons.
28 Dendroeca virens.	58 Vireo solitarius.
29 Dendroeca cærulescens.	59 Vireo Noveboracensis.
30 Dendroeca cærulea.	60 Collurio borealis.

\* Am. Jour. Sci. and Arts, vol. xlv, No. 2, pp. 249-274, April, 1843.

† Namely: the Wild Turkey (*Meleagris gallopavo*) and the Pinnated Grouse or Prairie Chicken (*Cupidonia cupido*).

‡ The collection of birds given by Linsley to the Yale Natural History Society, and kept for many years in the Yale Medical School, has recently been transferred to the Peabody Museum of Yale College.

- 61 *Pinicola enucleator*.
- 62 *Carpodacus purpureus*.
- 63 *Loxia curvirostra*, var. *Americana*.
- 64 *Ægiothus linaria*.
- 65 *Chrysomitris pinus*.
- 66 *Chrysomitris tristis*.
- 67 *Plectrophanes nivalis*.
- 68 *Passerculus Savanna*.
- 69 *Poocetes gramineus*.
- 70 *Coturniculus passerinus*.
- 71 *Ammodromus maritimus*.
- 72 *Ammodromus caudacutus*.
- 73 *Melospiza palustris*.
- 74 *Melospiza melodia*.
- 75 *Junco hyemalis*.
- 76 *Spizella monticola*.
- 77 *Spizella socialis*.
- 78 *Spizella pusilla*.
- 79 *Zonotrichia albicollis*.
- 80 *Zonotrichia leucophrys*.
- 81 *Passerella iliaca*.
- 82 *Euspiza Americana*.
- 83 *Goniaphia Ludoviciana*.
- 84 *Cyanospiza cyanea*.
- 85 *Cardinalis Virginianus*.
- 86 *Pipilo erythrophthalmus*.
- 87 *Dolichonyx oryzivorus*.
- 88 *Molothrus pecoris*.
- 89 *Agelæus phoeniceus*.
- 90 *Sturnella magna*.
- 91 *Icterus spurius*.
- 92 *Icterus Baltimore*.
- 93 *Scolecophagus ferrugineus*.
- 94 *Quiscalus purpureus*.
- 95 *Corvus Americanus*.
- 96 *Corvus ossifragus*.
- 97 *Cyanurus cristatus*.
- 98 *Tyrannus Carolinensis*.
- 99 *Myiarchus crinitus*.
- 100 *Sayornis fuscus*.
- 101 *Contopus borealis*?
- 102 *Contopus virens*.
- 103 *Empidonax Traillii*.
- 104 *Empidonax minimus* ("Acadicus").
- 105 *Antrostomus vociferus*.
- 106 *Chordeiles Virginianus*.
- 107 *Chaetura pelagica*.
- 108 *Trochilus colubris*.
- 109 *Ceryle alcyon*.
- 110 *Coccyzus erythrophthalmus*.
- 111 *Coccyzus Americanus*.
- 112 *Hylotomus pileatus*.
- 113 *Picus villosus*.
- 114 *Picus pubescens*.
- 115 *Sphyrapicus varius*.
- 116 *Centurus Carolinus*.
- 117 *Melanerpes erythrocephalus*.
- 118 *Colaptes auratus*.
- 119 *Strix flammea*, var. *Americana*.
- 120 *Bubo Virginianus*.
- 121 *Scops asio*.
- 122 *Otus vulgaris*, var. *Wilsonianus*.
- 123 *Brachyotus palustris*.
- 124 *Syrnium cinereum*.
- 125 *Syrnium nebulosum*.
- 126 *Nyctea Scandiaca*.
- 127 *Nyctale Acadica*.
- 128 *Circus cyaneus*, var. *Hudsonius*.
- 129 *Accipiter fuscus*.
- 130 *Falco communis*.
- 131 *Falco columbarius*.
- 132 *Falco sparverius*.
- 133 *Buteo borealis*.
- 134 *Buteo lineatus*.
- 135 *Buteo Pennsylvanicus*.
- 136 *Archibuteo lagopus*, var. *Sancti-Johannis*.
- 137 *Pandion haliaëtus*.
- 138 *Haliaëtus leucocephalus*.
- 139 *Cathartes aura*.
- 140 *Ectopistes migratorius*.
- 141 *Zenaidura Carolinensis*.
- 142 *Bonasa umbellus*.
- 143 *Ortyx Virginianus*.
- 144 *Squatarola Helvetica*.
- 145 *Charadrius fulvus*, var. *Virginicus*.
- 146 *Ægialitis vocifera*?
- 147 *Ægialitis Wilsonia*.
- 148 *Ægialitis semipalmata*.
- 149 *Ægialitis meloda*.
- 150 *Hæmatopus palliatus*.
- 151 *Streptilas interpres*.
- 152 *Steganopus Wilsoni*.
- 153 *Philohela minor*.
- 154 *Gallinago Wilsoni*.
- 155 *Macrorhamphus griseus*.
- 156 *Ereunetes pusillus*.
- 157 *Tringa minutilla*.
- 158 *Tringa maculata*.
- 159 *Tringa fuscicollis*.
- 160 *Tringa alpina*, var. *Americana*.
- 161 *Tringa canutus*.
- 162 *Calidris arenaria*.
- 163 *Limosa fedoa*.
- 164 *Limosa Hudsonica*.
- 165 *Totanus semipalmatus*.
- 166 *Totanus melanoleucus*.
- 167 *Totanus flavipes*.
- 168 *Totanus solitarius*.
- 169 *Tringoides macularius*.
- 170 *Actiturus Bartramius*.
- 171 *Numenius longirostris*.
- 172 *Numenius Hudsonicus*.
- 173 *Numenius borealis*.
- 174 *Ibis falcinellus*, var. *Ordii*.
- 175 *Ardea herodias*.
- 176 *Ardea candidissima*.
- 177 *Ardea cærulea*.
- 178 *Ardea virescens*.
- 179 *Nyctiardea grisea*, var. *nævia*.
- 180 *Botaurus minor*.
- 181 *Ardetta exilis*.
- 182 *Rallus longirostris*.
- 183 *Rallus elegans*.
- 184 *Rallus Virginianus*.
- 185 *Porzana Carolina*.

186	Porzana Noveboracensis.	213	Oedemia fusca.
187	Fulica Americana.	214	Oedemia perspicillata. .
188	Cygnus Americanus.	215	Erimaturus rubida.
189	Anser hyperboreus.	216	Mergus merganser.
190	Branta bernicla.	217	Mergus serrator.
191	Branta Canadensis.	218	Mergus cucullatus.
192	Branta Canadensis, var. Hutchinsii.	219	Sula bassana.
193	Anas boschas.	220	Sula fiber.
194	Anas obscura.	221	Graculus carbo.
195	Dafila acuta.	222	Graculus dilophus.
196	Chauleasmus streperus.	223	Stercorarius parasiticus.
197	Mareca Americana.	224	Larus marinus.
198	Querquedula Carolinensis.	225	Larus argentatus, var. Smithsonianus.
199	Querquedula discors.	226	Larus atricilla.
200	Spatula clypeata.	227	Larus Philadelphica.
201	Aix sponsa.	228	Sterna hirundo.
202	Fuligula marila.	229	Sterna supercilialis, var. Antillarum.
203	Fuligula collaris.	230	Oceanites oceanica.
204	Fuligula ferina, var. Americana.	231	Puffinus major.
205	Fuligula vallisneria.	232	Colymbus torquatus.
206	Bucephala clangula.	233	Colymbus septentrionalis.
207	Bucephala albeola.	234	Podiceps cristatus.
208	Harelda glacialis.	235	Podiceps griseigena, var. Holbölli.
209	Campylæmus Labradorius.	236	Podiceps cornutus.
210	Somateria mollissima.	237	Podilymbus podiceps.
211	Somateria spectabilis.	238	Utamania torda.
212	Oedemia Americana.	239	Uria grylle.

(B.) LIST OF THOSE SPECIES GIVEN BY LINSLEY IN HIS "*Catalogue of the Birds of Connecticut*," CONCERNING THE OCCURRENCE OF WHICH HE DID NOT HAVE SUFFICIENT PROOF.

1	Helmitherus Swainsoni.	18	Totanus chloropus.
2	Helminthophaga chrysoptera.	19	Tryngites rufescens.
3	Dendroeca Dominica.	20	Ardea egretta.
4	Oporornis agilis.	21	Gallinula galeata.
5	Petrochelidon lunifrons.	22	Porphyrio Martinica.
6	Ampelis garrulus.	23	Branta leucopsis.
7	Collurio Ludovicianus.	24	Histrionicus torquatus.
8	Collurio Ludovicianus, var. excubitorides.	25	Larus Delawarenensis.
9	Loxia leucoptera.	26	Larus tridactylus.
10	Quiscalus major.	27	Rhynchops nigra.
11	Picoides Arcticus.	28	Fulmarus glacialis.
12	Accipiter Cooperi.	29	Cymochorea leucorrhoea.
13	Recurvirostra Americana.	30	Puffinus obscurus.
14	Lobipes hyperboreus.	31	Fratercula Arctica.
15	Phalaropus fulicarius.	32	Mergulus alle.
16	Tringa maritima.	33	Lomvia troile.
17	Tringa subarquata.	34	Lomvia arra.

(C.) LIST OF THOSE "SPECIES" GIVEN BY LINSLEY, IN HIS "*Catalogue of the Birds of Connecticut*," WHICH REPRESENT IMMATURE, ABNORMAL, OR SEASONAL, PLUMAGES OF OTHER STATED SPECIES.

<i>Name used by Linsley.</i>	<i>Modern Equivalents.</i>
1 Regulus cristatus = tricolor.	Regulus satrapa.
2 Sylvia trochilus = aestiva.	Dendroeca aestiva.
3 Sylvia sphagnosa = Canadensis.	Dendroeca cærulescens.

<i>Name used by Linsley.</i>	<i>Modern Equivalents.</i>
4 Sylvia parus = Blackburniae.	Dendroeca Blackburniae.
5 Sylvia autumnalis = castanea.	Dendroeca castanea.
6 Sylvia Roscoe = trichas.	Geothlypis trichas.
7 Fringilla ambigua = Icterus pecoris.	Molothrus pecoris.
8 Strix Scandiaca = Virginica (albino)?	Bubo Virginianus.
9 Falco temerarius = columbarius.	Falco columbarius.
10 Falco buteoides = hyemalis.	Buteo lineatus.
11 Falco chrysaetos? Linné = leucocephalus.	Haliaeetus leucocephalus.
12 Falco Washingtoniensis = leucocephalus.	Haliaeetus leucocephalus.
13 Limosa Edwardsii? = Hudsonia.	Limosa Hudsonica.
14 Falligula nigra = Americana.	Oedemia Americana.
15 Phalacrocorax graculus = carbo.	Graculus carbo.
16 Larus capistratus = Bonapartii.	Larus Philadelphica.
17 Podiceps minor = Carolinensis.	Podilymbus podiceps.

(D.) LIST OF INTRODUCED AND DOMESTICATED SPECIES GIVEN BY LINSLEY, IN HIS "*Catalogue of the Birds of Connecticut.*" WHICH SCARCELY DESERVE TO BE MENTIONED AMONG OUR NATIVE BIRDS.

1 Columba domestica Linné.	4 Gallus domesticus Linné.
2 Pavo cristatus Linné.	5 Lophortyx Californicus Bonaparte.
3 Numida meleagris Linné.	6 Anas moschata Willoughby.

(E.) LIST OF THOSE SPECIES GIVEN BY LINSLEY IN HIS "*Catalogue of the Birds of Connecticut,*" WHICH WERE EITHER EXTERMINATED OR DRIVEN BEYOND THE STATE BEFORE HIS "CATALOGUE" WAS WRITTEN.

1 Meleagris gallopavo Linné.	2 Cupidonia Cupido Baird.
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(F.) LIST OF THOSE SPECIES GIVEN BY LINSLEY IN HIS "*Catalogue of the Birds of Connecticut,*" WHICH WERE INSERTED, PROBABLY, ON ERRONEOUS IDENTIFICATION.

1 Quiscalus major Vieillot.*	4 Larus canus Linné.
2 Empidonax Acadicus (Gmelin) Baird.†	5 Larus fuscus Linné.
3 Sylvia flava Linné.	

(G.) LIST OF THOSE SPECIES GIVEN BY LINSLEY IN HIS "*Catalogue of the Birds of Connecticut,*" THE IDENTITY OF WHICH I HAVE NOT BEEN ABLE TO DETERMINE.

1 Sylvia auricollis Latham.	2 Sylvia flava Linné.
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\* "*Probably a mistake.*" Coues' Birds of the Northwest, p. 204, 1874.

† Probably *E. minimus*.



E. *List of the Publications, containing Notes on the Birds of New England, to which reference has been made in the foregoing Review.*

A Description of New-England, by Captaine John Smith. Printed at London, 1616. [Tract 1, vol. ii.]

New Englands Trials. Written by Captaine John Smith, sometimes Governour of Virginia, and Admirall of New-England. London. Printed by William Iones. 1622.

New England's Plantation. Or a Short and true description of the commodities and discommodities of that Countrey.—Written by a reuerend Diuine now there resident. London, Printed by T. C. and R. C. for Michael Sparke, dwelling at the Signe of the *Blue Bible* in *Greene Arbor* in the little *Old Bailey*. 1630. [Reprinted in Peter Force's Historical Tracts, vol. i, Tract 12.]

Gov. Thomas Dudley's Letter to the Countess of Lincoln, March, 1631. Printed in full in Peter Force's Historical Tracts, vol. ii, Tract iv. Washington, 1838.

New English Canaan; Or New Canaan, containing An Abstract of New England. Composed in three Bookes, etc. Written by Thomas Morton, of Cliffords Inn, Gent. Upon ten Yeers Knowledge and Experiment of the Country. Printed by Charles Green. 1632. [Reprinted in Peter Force's Historical Tracts, vol. ii, Tract 5. 1838.]

New Englands Prospect. A true, lively, and experimentall description of that part of *America*, commonly called *Nevv England*; discovering the state of that Countrie, both as it stands to our new-come *English* Planters; and to the old Native Inhabitants. Laying downe that which may both enrich the knowledge of the mind-traveling Reader, or benefit the future Voyager. By William Wood. Printed at London, etc. 1634.

New-England's Rarities Discovered: in Birds, Beasts, Fishes, Serpents, and Plants of that Country. [Etc.] By John Josselyn, Gent. London. 1672. [Reprinted in *Archæologia Americana*, vol. iv, pp. 133-238.]

An Account of two Voyages to New-England, etc. By John Josselyn, Gent. The Second Addition. London. Printed for G. Widdowes at the Green Dragon in St. Pauls Church-yard, 1675. [Reprinted in Collections of the Massachusetts Historical Society, vol. iii, 3d Series. 1833.]

Travels into North America; containing its Natural History, and a Circumstantial Account of its Plantations and Agriculture in general, etc. etc. By Peter Kalm. Translated into English, by John Reinhold Forster, F.A.S. Vol. ii. London, 1771.

Arctic Zoölogy. By Thomas Pennant. Vol. ii. 1785.

The History of New-Hampshire. By Jeremy Belknap, A.M. Vol. iii. Boston, 1791.

The Natural and Civil History of Vermont. By Samuel Williams, LL.D. Published according to Act of Congress. Printed at Walpole, New Hampshire, 1794.

A Statistical Account of the County of Middlesex, in Connecticut. By David D. Field. Published by the Connecticut Academy of Arts and Sciences. Middletown, Conn. Printed by Clark & Lyman. April, 1819.

American Ornithology. By Alexander Wilson. Edinburgh, 1831.

A Manual of the Ornithology of the United States and Canada. By Thomas Nuttall. 1832.

Report on the Geology, Mineralogy, Botany, and Zoology of Massachusetts. Made and published by order of the Government of that State, etc. By Edward Hitchcock (Report on Birds, by Ebenezer Emmons, M.D.). Amherst, 1833.

The Birds of North America. By John James Audubon. 1831-9.

A Report on the Ornithology of Massachusetts. By William B. O. Peabody. 1839.

History of Vermont, Natural, Civil, and Statistical. In three parts, with a new map of the State, and 200 engravings. By Zadock Thompson. Burlington: Chauncey Goodrich, 1842. Also Appendix to same, published in 1853.

A Catalogue of the Birds of Connecticut, arranged according to their natural families. By the Rev. James H. Linsley. [Published in the Am. Jour. Sci. and Arts, vol. xlv, No. 2, pp. 249-74. April, 1843.]

The Birds of Long Island. By J. P. Giraud, Jr. New York, 1844.

The Birds of Essex County, Mass. By F. W. Putnam. [Published in Proceed. Essex Inst., vol. i, pp. 201-31. 1856.]

A List of Birds observed at Grand Menan and at Yarmouth, N. S., from June 16 to July 8, 1856. By Dr. Henry Bryant. [From the Proceedings of the Boston Society of Natural History, vol. vi. March, 1857.]

Birds of North America. By S. F. Baird. [Vol. ix of Pacific Railroad Reports, 1858.]

Catalogue of the Birds found at Norway, Oxford County, Maine. By A. E. Verrill. With a List of the Birds found in Maine not observed at Norway. [From Proceedings of the Essex Institute, vol. iii. 1863.]

Catalogue of the Birds found in the Vicinity of Calais, Maine, and about the Islands at the Mouth of the Bay of Fundy. By George A. Boardman. [Edited by Prof. A. E. Verrill.] [From the Proceedings of the Boston Society of Natural History, vol. ix. Sept., 1862.]

Catalogue of the Birds found at Springfield, Mass., with notes on their Migrations, Habits, &c.; together with a List of those Birds found in the State not yet observed at Springfield. By J. A. Allen. 1864. [From the Proceedings of the Essex Institute, vol. iv, No. 2, pp. 48-98. July, 1864.]

A Descriptive Catalogue of the Birds of Massachusetts. By E. A. Samuels. 1864. [From Massachusetts Agricultural Report. 1863.]

Catalogue of Birds found in the vicinity of Waterville, Kennebec County, Maine. By Charles E. Hamlin. [Printed in the Tenth Annual report of the Secretary of the Maine Board of Agriculture, pp. 168-173. 1865.]

History of Lynn, Essex County, Massachusetts: including Lynnfield, Saugus, Swampscot, and Nahant. By Alonzo Lewis and James R. Newhall. Boston, 1865.

A List of the Birds of New England. By Elliott Coues, Assistant Surgeon U. S. A. [Reprinted from the Proceedings Essex Institute, vol. v.] Salem, Mass. pp. 71. 1868.

The Birds of East Pennsylvania and New Jersey. By William P. Turnbull. 1869.

A Catalogue of the Birds of Coos County, N. H., and Oxford County, Maine. By C. J. Maynard, with Notes by William Brewster. Oct., 1871. [From the Proceedings of the Boston Society of Natural History, vol. xiv. Oct. 18, 1871. Repaged.]

Key to North American Birds. By Elliott Coues. 1872.

A Partial Catalogue of the Birds of Grand Menan, New Brunswick. By Harold Herrick. [From the Bulletin of the Essex Institute, vol. v, Nos. 2 and 3. 1873.]

The Birds of Florida. By C. J. Maynard. 1873.

A History of North American Birds. By Baird, Brewer and Ridgway. 1874.

Birds of the Northwest. By Elliott Coues. 1874-5.

The Birds of New England and Adjacent States. By Edward A. Samuels. Boston, 1875.

A Catalogue of the Birds of New England. By Thomas M. Brewer. 1875.

The Naturalist's Guide. By C. J. Maynard.

The Land and Game Birds of New England. By H. D. Minot. Salem, 1877.

American Journal of Science and Arts. New Haven.

Proceedings of the Boston Society of Natural History.

Annals of the Lyceum of Natural History. New York.

Proceedings of the Essex Institute.

Bulletin Essex Institute.

Bulletin of the Museum of Comparative Zoölogy, Cambridge.

American Naturalist. Salem.

Bulletin of the Nuttall Ornithological Club. Cambridge, 1876-7.

New England Farmer.

Hartford Times, for 1861.

Rod and Gun=American Sportsman.

Collections of the Massachusetts Historical Society.

Report of the Secretary of the Maine Board of Agriculture.

### III. A LIST OF WRITINGS RELATING TO THE METHOD OF LEAST SQUARES, WITH HISTORICAL AND CRITICAL NOTES. BY MANSFIELD MERRIMAN.

THE following list contains the titles of 408 papers, books and parts of books, relating to the Method of Least Squares and the Theory of accidental Errors of Observation, chronologically arranged according to their dates of publication. The first was issued in the year 1722 and the last in 1876. Previous to 1805, the year of LEGENDRE's announcement of the principle of Least Squares, there are 22 titles; since 1805 there is a continual yearly increase in the number of titles,—thus:

From 1805 to 1814 inclusive, there are 18 titles.

"	1815	"	1824	"	"	30	"
"	1825	"	1834	"	"	32	"
"	1835	"	1844	"	"	45	"
"	1845	"	1854	"	"	63	"
"	1855	"	1864	"	"	71	"
"	1865	"	1874	"	"	95	"

These books and memoirs are in eight languages, and classified according to the place of publication, they fall under twelve countries. It may be interesting to note the number belonging to each, viz:

<i>Countries.</i>		<i>Languages.</i>	
Germany .....	153	German .....	167
France .....	78	French .....	110
Great Britain .....	56	English .....	90
United States .....	34	Latin .....	16
Belgium .....	19	Italian .....	9
Russia .....	16	Dutch .....	7
Italy .....	14	Danish .....	5
Austria .....	10	Swedish .....	4
Switzerland .....	9		
Holland .....	7	Total .....	408
Sweden .....	7		
Denmark .....	5		
Total .....	408		

The 408 titles may be roughly classified as 313 memoirs, 72 books and 23 parts of books. They were written by 193 authors, 127 of whom produced only one book or paper each.

In preparing this list I have been able to use only the libraries of Yale College, (including that of the Connecticut Academy of Arts and Sciences,) but I think no work in those libraries relating to the subject has been left unconsulted. Out of the total 408 works, I have seen 312; the titles of these and the accompanying notes have been drawn from actual inspection. I have made no attempt to consult the literature of the Russian and Hungarian languages, and with wider library facilities the number of titles in the Italian, Dutch and Scandinavian languages would undoubtedly have been greater. Of course no work of this kind can be regarded as complete.

It has been my aim to record all writings which can be considered as contributions to the science of the Adjustment of Observations, and I think that those marked as actually inspected may be truly so regarded. Many works on Astronomy and Probability which devote but a page or two to the subject, as well as numerous practical papers, in which the Method of Least Squares is used incidentally and briefly, have been left unnoticed; to record all of these would be well nigh impossible, nor would the value of the list be thereby increased. Among the 96 which I have not seen there may possibly be a few that would be rejected after actual inspection.

The following is the arrangement of the list.

At the head of a title is placed the year of publication. In the case of memoirs this often differs from the date of the volume in which they are contained; for instance, Nautical Almanacs are published several years preceding and Transactions of Learned Societies often several years after the date which they bear. When a memoir is published in parts extending over two or more years it is recorded under the date of the first part.

The author's name follows the date of publication. In the index at the end of the list the full names of authors are given, and a distinction is made in the text when two persons of the same surname have written on the subject.

The titles of books, and pamphlets published as books, are printed in *italics*, and the titles of memoirs in ordinary type. Those which I have actually inspected have their titles enclosed in single quotation marks ('—') and these are intended to correspond with the originals in punctuation, spelling and when possible in the use of capitals.

The place of publication of books is given, with references to subsequent editions or translations. The usual terms 4to, 8vo, etc. are added, although they give little idea of the size of a book, and the

number of pages is noted whenever I have been able to ascertain it. When a single chapter only of a book relates to the subject, the title of that chapter is treated like a memoir.

After the title of a memoir is placed *in italics* the title of the volume containing it. This is abridged in the usual manner, but the words of the title are never transposed. For instance, *Bulletin des Sciences de la Société Philomathique de Paris* is abridged into *Bull. Soc. Philom. Paris*. In a few instances I have added the place of publication or have prefixed the name of the editor in order to ensure perfect clearness. The number of the volume and the pages which are devoted to the memoir are given; the mention of the year renders it unnecessary to note the various series.

When the work was begun it was intended to make the notes very full so as to give a tolerably complete history of the Method of Least Squares. But as the number of titles began to multiply under research it became evident that the plan would produce a manuscript too voluminous for publication. The notes were hence abbreviated into their present form. The work begun as historical has, I am afraid, ended by being largely bibliographical.

Sometimes the notes give an account of the contents of a memoir or an estimate of its value; sometimes they take the form of a direct quotation from the memoir itself or state the opinion of some subsequent reviewer; and occasionally they offer critical remarks of my own. But always they aim to give such cross references as will enable the student to follow up special lines of investigation and gain the fullest information concerning a particular memoir or book. Brief as the notes are, I hope they will be found at least suggestive by those who use them. To the future historians of mathematical science they will undoubtedly be of very great value.

The mode of cross reference usually adopted is to mention simply the year and author. Thus "1818 BESSEL" refers either to a book published in 1818 by BESSEL or to notes under that heading.

The following table points out some of the most valuable papers on the proofs of the Method of Least Squares:

First publication of the Method.....	see 1805	LEGENDRE.
First and Second Proofs.....	1808	ADRAIN.
Third Proof.....	1809	GAUSS.
Fourth Proof.....	1810	LAPLACE.
Fifth Proof.....	1812	LAPLACE.
Theory and Practice compared.....	1818	BESSEL.
Sixth Proof.....	1823	GAUSS.

Seventh Proof.....	see 1825	IVORY.
Eighth Proof .....	1826	IVORY.
Proof of the Arithmetical Mean .....	1832	ENCKE.
Ninth Proof.....	1837	HAGEN.
Tenth Proof .....	1838	BESSEL.
LAPLACE'S Proof extended and improved.....	1844	ELLIS.
Eleventh Proof.....	1844	DONKIN.
ADRAIN'S Second Proof rediscovered.....	1850	HERSCHEL.
Twelfth Proof.....	1856	DONKIN.
On the Arithmetical Mean .....	1864	DEMORGAN.
[Thirteenth Proof].....	1870	CROFTON.
Analysis of several Proofs.....	1872	GLAISHER.
Proof of the Arithmetical Mean.....	1875	SCHIAPARELLI.

I have drawn information from every source within my reach. On the Proofs of the Method I have found GLAISHER'S memoir of 1872 of the greatest value, and while working on the early writers TONHUNTER'S *History of Probability* was continually before me. It is here also the place to acknowledge my indebtedness to Prof. H. A. NEWTON of Yale College for valuable suggestions and kind assistance.

1722 CORES. 'Æstimatio errorum in mixta mathesi, per variationes partium trianguli plani et sphærici.' *Opera miscellanea* (appended to *Harmonia mensurarum*; Cantabrigiæ, 4to), pp. 1-22. —Memoir republished, Lemgovix, 1768, 8vo.

Only the closing paragraph relates to accidental errors of observation; this gives the following rule: "Sit  $p$  locus Objecti alicujus ex Observatione prima definitus,  $q, r, s$  ejusdem Objecti loca ex Observationibus subsequentibus; sint insuper  $P, Q, R, S$  pondera reciproce proportionalia spatiis Evagationum, per quæ se diffundere possint Errores ex Observationibus singulis prodeuntes, quæque dantur ex datis Errorum Limitibus; & ad puncta  $p, q, r, s$  posita intelligantur pondera  $P, Q, R, S$ , & inveniat eorum gravitatis centrum  $Z$ : dico punctum  $Z$  fore Locum Objecti maxime probabilem, qui pro vero ejus loco tutissime haberi potest."

CORES'S rule only agrees with modern methods when the observations are directly made upon one quantity. See LAPLACE, *Théorie analytique des Probabilités*, third edition, p. cxxxviii, p. 346; and IVORY, *Phil. Mag.*, 1825, Vol. LXV, p. 4.

1749 EULER. *Pièce qui a remporté le prix de l'Académie royale des sciences en 1748, sur les inégalités du mouvement de Saturne et de Jupiter*. Paris, 4to.

Contains a method for the combination of linear equations similar to the following.

1750 MAYER. Abhandlung über die Umwälzung des Mondes um seine Axe. *Kosmographische Nachrichten u. Sammlungen* for 1748, pp. 52-183.

By twenty-seven observations upon the position of a moon spot MAYER obtained twenty-seven equations each containing three unknown quantities. To solve these he added together those nine equations in which the values of the coefficients of one of the unknown quantities were the greatest, then the nine in which these coefficients were the least and lastly the remaining nine; thus obtaining three resulting equations with three unknown quantities.

MAYER's method is given by LALANDE, *Astronomie*, second edition, Vol. III, pp. 418-428. See WOLF, *Handbuch der Math.*, Vol. I, p. 279, Vol. II, p. 199; and also below, 1830 FRANCOEUR.

[1754] KÄSTNER. Om geometrisk aberration. *Svenska Vetensk. Acad. Handl.* for 1753, p. 126. —German translation in *Schwedische Akad. Abhandl.* for 1753, p. 131.

Treats of errors in Surveying and probably contains nothing of value on the theory of accidental errors. See also the same memoirs for 1768, p. 147 and p. 159.

1755 BOSCOVICH. *De littera expeditione per Pontificam ditionem ad dimetiendos duos meridiani gradus.* Romae, 4to, pp. xxii, 516. —French translation by HUGON entitled *Voyage astronomique et géographique*....; Paris, 1770, 4to.

A method of combination of observations for the determination of the mean ellipticity of the earth from measured arcs of the meridian is here used. The method itself is proved in the French translation; see below 1760. For description of the book see TODHUNTER, *History of Theories of Attraction*...., Vol. I, pp. 305-321, 332-334.

1756 SIMPSON. 'A letter to the Right Honourable George Earl of Macclesfield, President of the Royal Society, on the Advantage of taking the Mean of a number of Observations, in practical Astronomy.' *Phil. Trans. Lond.* for 1755, Vol. XLIX, Pt. I, pp. 82-93. —Reprint, see 1757.

This memoir is interesting and valuable as being the first in which the Theory of Probability is applied to the discussion of errors of observation and in which the idea of a law of facility of error is implied. At the beginning of the letter SIMPSON says that his attention had been called to the subject by the fact that "some persons, of considerable note, have been of opinion, and even publicly maintained, that one single observation, taken with due care, was as much to be relied on as the Mean of a great number."

The letter contains two propositions; the first gives a method of determining the probability that the error of the mean of  $n$  observations shall be less than an assigned value, provided it is equally prob-



able that the error of a single observation may be any one of the quantities,  $-v, \dots -3, -2, -1, 0, 1, 2, 3, \dots v$ . The second gives a method of determining that probability, provided the probabilities of the single errors  $-v, -v+1, \dots -1, 0, 1, \dots v-1, v$  are proportional to the terms  $1, 2, \dots v, v+1, v, \dots 2, 1$ . This is illustrated by a numerical example. SIMPSON remarks that the advantage of the mean can be shown, whatever series be used to express the chances of the errors.

1757 SIMPSON. 'An Attempt to show the Advantage arising by Taking the Mean of a Number of Observations, in practical Astronomy.' *Miscellaneous Tracts*.... (London, 4to), pp. 64-75.

A reprint of the preceding, the opening and closing paragraphs being omitted and nearly four pages of new matter added. We find here the following axioms stated for the first time; 1. that positive and negative errors are equally probable, 2. that there are certain assignable limits within which all errors may be supposed to fall.

In the added matter the case of *continuous* errors is discussed, and the probability that the error of the mean is less than an assigned value found for the case of the second proposition by making  $v$  and other quantities in the formulæ infinite. SIMPSON represents the law of facility of error geometrically by the sides of an isosceles triangle and draws a curve to show the increased precision of the mean as compared with single observations. He closes by finding under the same supposition as to the law of facility, the probability that the mean is nearer to the truth than a single observation taken at random. The whole memoir must have been extremely valuable at the time of its publication.

1760 BOSCOVICH. De recentissimis graduum dimensionibus, et figura, ac magnitudine terrae inde derivanda. *Philosophia recentior* à BENEDICTO STAY.... (Romae, 3 vols., 8vo), Vol. II, pp. 406-426.

A method of combining discordant observations upon the lengths of degrees of the earth's meridian is here given. The adjustment is effected under the two conditions that the sum of the negative errors shall be equal to the sum of the positive errors, and that each sum shall have the least possible value. The problem was solved by a geometric construction depending upon the properties of the centre of gravity of figures.

The method is also given in the French translation of BOSCOVICH's work of 1755. See LINDENAU in *Zach's Monatliche Correspondenz*, 1806, Vol. XIV, p. 132; TODHUNTER, *Hist. of Theories of Attraction*...., Vol. I, pp. 321-332; and below, 1785 BERNOULLI, 1792 LAPLACE.

1760 LAMBERT. *Photometria sive de mensura et gradibus luminis*.... Augustæ Vindelicorum, 8vo, pp. [xxx], 547.

Contains many remarks on the arithmetical mean and also proposes a method for judging of the precision of the measurements, which

consists in comparing the mean with a new mean found after rejecting that observation deviating most from the first mean. See *Nova Acta Lipsiæ*, 1760, p. 560; also *Lambert's Beyträge*.... Vol. I, p. 426.

1765 LAMBERT. 'Theorie der Zuverlässigkeit der Beobachtungen und Versuche.' *Beyträge zum Gebrauche der Mathematik*.... (Berlin, 1765-70, 3 vols., 8vo; second ed., 1792), Vol. I, pp. 424-488.

Contains a method of adjusting simple observations founded on the principle that the algebraic sum of the errors shall be zero. The method is illustrated by the determination of empirical formulæ for the length of the seconds pendulum, the declination of the magnetic needle, etc.

1774 LAPLACE. 'Determiner le milieu que l'on doit prendre entre trois observations données d'un même phénomène.' *Mém. Acad. Paris, par divers savans [étrangers]*, Vol. IV, pp. 634-644.

This is Part V of the 'Mémoire sur la probabilité des causes par les évènements,' which occupies pages 621-656 of the volume. It contains the first attempt to deduce a rule for the combination of observations from the principles of Probability.

LAPLACE begins by saying that the law of probability of errors of observation may be represented by a curve whose equation is  $y = \varphi(x)$ ,  $x$  being any error and  $y$  its probability; and this curve must have three properties: 1st, it must be symmetrical with reference to the axis of  $y$ , since positive and negative errors are equally probable; 2nd, the axis of  $x$  must be an asymptote, since the probability of the error  $\infty$  is 0; 3rd, the area of the curve must be unity, since it is certain that an error will be committed.

LAPLACE takes  $\varphi(x)$  as  $\varphi(x) = \frac{1}{2} m e^{-m|x|}$  ( $x$  being regarded as always positive), but his reasons for doing so are slight. With this law he finds the mean of three observations, regarding it as corresponding to an ordinate which divides a curve  $u = \varphi(x_1)\varphi(x_2)\varphi(x_3)$  into two equal parts. His result is as follows: Let  $M_1$ ,  $M_2$  and  $M_3$  be the three measurements, of which  $M_1$  is the least; let  $M_1 + x$  be the mean; it is required to find  $x$ . Put  $M_2 - M_1 = p$  and  $M_3 - M_2 = q$ ; then  $x$  is given by

$$x = p + \frac{1}{m} \log_e (1 + \frac{1}{2} e^{-mp} - \frac{1}{2} e^{-mq}),$$

in which  $m$  is a constant depending upon the precision of the observation. LAPLACE then shows that this value cannot agree with the rule of the arithmetical mean, and he computes a table for finding  $x$  for certain given ratios of  $q$  to  $p$ . For instance

if $q = 0.0 p$ .....	$x = 0.860 p$ ,
$q = 0.1 p$ .....	$x = 0.894 p$ ,
$q = 0.2 p$ .....	$x = 0.916 p$ ,
$q = 0.3 p$ .....	$x = 0.932 p$ ,
.....	.....

Thus if three measurements of an angle give

$$M_1 = a^\circ b' 0'', \quad M_2 = a^\circ b' 40'' \quad \text{and} \quad M_3 = a^\circ b' 50'',$$

we have  $p=40''$ ,  $q=10''$  and  $g=0.25p$ ; then from the table  $x=37''$  and the adjusted result is  $a^\circ b' 37''$ , while by the usual rule of the average we would have  $a^\circ b' 30''$ . By LAPLACE's table the mean will lie nearer to the two observations which most nearly agree, than in the common method.

For remarks on this memoir see TODHUNTER, *History of Probability*, p. 469, and GLAISHER, *Mem. Astron. Soc. Lond.*, 1872, Vol. XXXIX, pp. 121-123.

[1774] LAGRANGE. "Mémoire sur l'utilité de la méthode de prendre le milieu les résultats de plusieurs observations; dans lequel on examine les avantages de cette méthode par le calcul des probabilités; & où l'on résoud différens problèmes relatifs à cette matière." *Miscellanea Taurinensia* (*Mél. Soc. Turin*) for 1770-1773, Vol. V, pp. 167-232 of the math. part.

This memoir is a more thorough presentation of the subject treated by SIMPSON in 1757 with much new matter added. LAGRANGE makes no allusion however to previous writings on the subject. The expression "Law of Facility of Error" occurs here for the first time.

For an extended account of the contents of the memoir see TODHUNTER, *History of Probability*, pp. 301-313. See also below 1785 BERNOULLI, 1788 EULER, and 1804 TREMBLEY. In 1850 ENCKE gives a translation of part of the memoir, with comments.

1778 BERNOULLI (Daniel). 'Dijudicatio maxime probabilis plurium observationum discrepantium atque verisimillima inductio inde formanda.' *Acta Acad. Petrop.* for 1777, Pt. I, pp. 3-23 of the memoirs.

The now familiar illustration of a marksman firing at a target is here introduced, and the conclusion drawn that small errors are more probable than large ones, and that the method of taking the arithmetical mean "non sine ratione dubitare potest," since it supposes the observations of equal weight.

DANIEL BERNOULLI takes a circle  $y=\sqrt{r^2-x^2}$  as representing the law of facility of error,  $y$  being proportional to the probability of the error  $x$ , and  $r$  a constant. Then if observations give the errors  $x_1, x_2, x_3, \dots$ , the product  $\sqrt{r^2-x_1^2} \sqrt{r^2-x_2^2} \sqrt{r^2-x_3^2}$  must be a maximum to give the most probable value of the observed quantity. He finds that this value coincides with that given by the rule of the arithmetical mean for one and for two observations, and that it nearly coincides for three when a suitable value is given to  $r$ . For a greater number than three his method leads to unmanageable equations. He closes by remarking that the problem is indeterminate. See ZACH's *Monatliche Correspondenz*, 1805, Vol. XI, pp. 486-490.

DANIEL BERNOULLI's method agrees closely with modern theory. See 1778 EULER, 1785 BERNOULLI and TODHUNTER, *History of Probability*, p. 236.

1778 EULER. 'Observationes in praecedentem dissertationem Illustr. BERNOULLI.' *Acta Acad. Petrop.* for 1777, Part I, pp. 24-33 of the memoirs.

EULER considers that DANIEL BERNOULLI is correct in objecting to the arithmetical mean when the observations are of unequal precision, but that he "was quite arbitrary in proposing to make the product of the probabilities a maximum. EULER proposes another method which amounts to making the sum of the fourth powers of the probabilities a maximum."—TODHUNTER, *Hist. of Probability*, p. 237.

1781 LAPLACE. 'Mémoire sur les Probabilités.' *Hist. Acad. Paris* for 1778, pp. 227-332 of the math. part.

Pages 322-332 are devoted to the discussion of the mean to be taken between discordant observations. LAPLACE says that by the expression *mean* or *mean result* an infinite number of things may be understood. Of these the one which is implied in adjusting observations is a value such that the resulting error shall be a minimum, and this corresponds to a value such that the sum of the errors, each multiplied by its probability shall be a minimum. The method of his memoir of 1774 is then substantially repeated.

LAPLACE remarks that if  $\pm a$  be the limits of error, the law of facility ought to be  $\varphi(x) = \frac{1}{2a} \log_e \frac{a}{x}$ . His methods lead to unmanageable equations.

1785 BERNOULLI (Jean, III). 'Milieu.' Art. in the *Encyclopédie Méthodique* (Paris, 4to), Vol. II, pp. 404-409. —Second edition, 1789, entitled *Dictionnaire Encycl. des Mathématiques*.

BOSCOVICH's method of 1760 and LAMBERT's of 1765 are referred to, and an account is given of DANIEL BERNOULLI's memoir of 1778, which differs slightly from the memoir itself. An account of LA GRANGE's memoir of 1774 is presented with considerable fullness. See TODHUNTER, *Hist. of Probability*, p. 442.

1788 EULER. 'Eclaircissemens sur le mémoire de Mr DE LA GRANGE inséré dans le V<sup>e</sup> volume de *Mélanges de Turin*, concernant la méthode de prendre le milieu entre les résultats de plusieurs observations, &c.' *Nova Acta Acad. Petrop.* for 1785, Vol. III, pp. 289-297 of the memoirs.

The memoir seems to have no value; See TODHUNTER, *Hist. of Probability*, p. 250.

1789 LEGENDRE. 'Mémoire sur les Opérations trigonométriques, dont les résultats dépendent de la figure de la terre.' *Hist. Acad. Paris* for 1787, pp. 352–383 of the memoirs.

The method of *indeterminate corrections*, afterwards of so much use in the computations of Least Squares is here stated and used, although perhaps not for the first time. See 1820 LEGENDRE.

1792 LAPLACE. 'Sur les degrés mesurés des méridiens, et sur les longueurs observées du pendule.' *Hist. Acad. Paris* for 1789, pp. 18–43 of the memoirs.

The matter of this memoir is mostly reproduced in Sections 39–42 of Chap. V, Book III, of the *Traité de mécanique céleste*.

First a method is presented of determining an elliptic meridian so that the greatest error shall be a minimum; see 1831 CAUCHY. Secondly a method is developed for finding an ellipse subject to the following conditions: "1° que la somme des erreurs soit nulle; 2° que la somme des erreurs prises toutes avec le signe + soit un minimum." LAPLACE mentions that BOSCOVICH (1760) had solved the same problem by a different method. He alludes to the ellipse thus determined as "l'ellipse la plus probable."

1799 KRAMP. 'Table première. Intégrales de  $e^{-t} dt$ , depuis une valeur quelconque de  $t$  jusqu'à  $t$  infinie.' and 'Table seconde. Logarithmes des intégrales  $te^{-t} dt$ .' *Analyse des refractions* . . . (Strasbourg, 4to), pp. 195–206.

For description of these tables, afterwards of so great use in the Theory of Errors, see GLAISHER, *Lond. Phil. Mag.*, 1871, Vol. XLII, p. 431.

1804 TREMBLEY. 'Observations sur la méthode de prendre les milieux entre les observations.' *Mémoires Acad. Berlin* for 1801, pp. 29–58 of the math. part.

"Appears to be of no value whatever."—TODHUNTER, *Hist. of Probability*, p. 428.

1804 PRONY. *Recherches physico-mathématiques sur la théorie des eaux courantes*. Paris, 4to.

Contains applications of LAPLACE's methods of 1792 to the deduction of empirical formulæ from discordant observations.

1805 LEGENDRE. 'Nouvelles méthodes pour la détermination des orbites des comètes.' Paris, 4to, pp. viii, 80. —Second edition, see 1806.

The date 1806 is generally given for this book, in which year a second edition seems to have been issued. The copy before me is plainly dated, "An XIII—1805."

In the preface LEGENDRE gives an outline of his method for computing orbits. On page viii he says: "Il faut ensuite, lorsque toutes les conditions du problème sont exprimées convenablement, déterminer les coefficients de manière à rendre les erreurs les plus petites qu'il est possible. Pour cet effet, la méthode qui me paroît la plus simple et la plus générale, consiste à rendre *minimum* la somme des carrés des erreurs. On obtient ainsi autant d'équations qu'il y a de coefficients inconnues; ce qui achève de déterminer tous les éléments de l'orbite.... la méthode dont je viens de parler, et que j'appelle *Méthode des moindres carrés*, peut être d'une grande utilité...."

On page 64 is an application of the method to the solution of three equations with two unknown quantities, in which the now well-known rule for the solution of normal equations is followed. On page 68 and 69 are references to its use. Pages 72-80 constitute an Appendix "Sur la Méthode des moindres carrés." In this, after having mentioned that it is impossible that the sum of the errors should be zero when the number of given equations exceeds that of the unknown quantities, LEGENDRE says: "De tous les principes .... je pense qu'il n'en est pas de plus général, de plus exact, ni d'une application plus facile que celui .... qui consiste à rendre *minimum* la somme des carrés des erreurs. Par ce moyen, il s'établit entre les erreurs une sorte d'équilibre qui empêchant les extrêmes de prévaloir, est très-propre à faire connoître l'état du système le plus proche de la vérité."

LEGENDRE then proceeds to deduce the rule for the formation of "l'équation du *minimum* par rapport à l'une des inconnues," or as we now say of a normal equation. His notation is the following: in the  $n$  equations

$$\begin{aligned} 0 &= a + bx + cy + \dots \\ 0 &= a' + b'x + c'y + \dots \\ 0 &= a'' + b''x + c''y + \dots \\ &\dots \dots \dots \end{aligned}$$

$a, b, c, \dots, a', b', c' \dots$  are known by observation or theory, and  $x, y, \dots$  are to be determined. By forming the sum of the squares of these equations, differentiating with reference to each unknown separately and placing the derivatives equal to zero, he finds

$$\begin{aligned} 0 &= f_{ab} + x f_{b^2} + y f_{bc} + \dots \\ 0 &= f_{ac} + x f_{bc} + y f_{c^2} + \dots \\ &\dots \dots \dots \end{aligned}$$

which are the same in number as the unknown quantities  $x, y, \dots$ , and in which

$$\begin{aligned} f_{ab} &= ab + a'b' + a''b'' + \dots \\ f_{b^2} &= b^2 + b'^2 + b''^2 + \dots \\ &\dots \dots \dots \end{aligned}$$

LEGENDRE next demonstrates that the rule of the arithmetical mean is a particular case of his general principle. He then supposes the position of a point in space to be determined by three observations and finds the values of its coördinates given by the method. Noticing their identity with those for the centre of gravity of three points in space, he announces that the sum of the squares of the distances of

all the molecules of a body from its centre of gravity must be a minimum, and that hence "la méthode des moindres quarrés fait connoître, en quelque sorte, le centre autour duquel viennent se ranger tous les résultats fournis par l'expérience, de manière à s'en écarter le moins qu'il est possible." A numerical example of the application of the method to the determination from five observations of the form of a meridian of the earth closes the book.

The honor of the first publication of the Method of Least Squares belongs to LEGENDRE. Although he failed to claim that his method gives most probable or most advantageous results, yet the remarks above quoted indicate that he fully recognized it as a rule giving a plausible and reasonable mean. See below 1814.

1805 PUISSANT. *Traité de Géodésie, ou Exposition des Méthodes astronomiques et trigonométriques*..... Paris, 4to. —Third edition, see 1842.

This contains an explanation and application of LEGENDRE's Method of Least Squares. See review in *Zach's Monatliche Correspondenz*, Vol. XVI, p. 455.

1806 LEGENDRE. 'Supplément aux Nouvelles Méthodes pour la détermination des orbites des comètes.' Paris, 4to, pp. 55.

The copy of this supplement which is before me is preceded by a title page reading, "*Nouvelles méthodes pour la détermination des orbites des comètes; avec un Supplément*..... A Paris, . . . Année 1806." This title page was probably prefixed to copies of the work of 1805, with the Supplement added, as the date 1806 is usually stated for it. A second Supplement appeared in [1820].

On pages 28 and 43 the Method of Least Squares is used.

1806 LINDENAU. 'Ueber den Gebrauch der Gradmessungen zur Bestimmung der Gestalt der Erde.' *Zach's Monatliche Correspondenz*, Vol. XIV, pp. 113-158, etc.

LAPLACE's method of 1792 is stated and used in the discussion of the most probable elliptic meridian. The method is attributed to BOSCOVICH; see 1760.

On pages 138-143 "die.... von LEGENDRE vorgeschlagenen Methode, die er *Méthode des moindres quarrés* nennt" is explained and applied in the determination of the elliptic meridian. The date of LEGENDRE's *Nouvelles méthodes*.... is given as 1806.

1806 GAUSS. 'II Comet vom Jahr 1805.' *Zach's Monatl. Corres.*, Vol. XIV, pp. 181-186.

On page 184 GAUSS says: "LEGENDRE's Werk.... habe ich noch nicht gesehen. Ich hatte mit Fleiss mir deswegen keine Mühe gegeben, um bey der Arbeit an meiner Methode ganz in der Kette meiner eigenen Ideen zu bleiben. Durch ein paar Worte, die DE LA LANDE in der letztern *Historie de l'Astronomie*, 1805, fallen lässt,

*méthode des moindres quarrés*, gerathe ich auf die Vermuthung, dass ein Grundsatz, dessen ich mich schon seit zwölf Jahren bey mancherley Rechnungen bedient habe, und den ich auch in meinem Werke mit gebrauchen werde, ob er wol zu meiner Methode eben nicht wesentlich gehört,—dass dieser Grundsatz auch von LEGENDRE benutzt ist."

The work of LEGENDRE here alluded to is the *Nouvelles méthodes* ... 1805, and that of GAUSS the *Theoria motus* ... 1809, then in preparation. GAUSS mentions some of the advantages of his method for computing orbits but gives no hint of the principle of Least Squares.

1808 BOWDITCH. 'Solution of Mr. PATTERSON's Prize Question for correcting a survey, proposed in No. II. page 42, No. III. page 68, by NATHANIEL BOWDITCH, to whom the Editor has awarded the prize of ten dollars.' *The Analyst or Math. Museum*, Vol. I, pp. 88-92.

The Prize Question was: "In order to find the content of a piece of ground, ... I measured, with a common circumferentor and chain, the bearings and lengths of its several sides, .... But upon casting up the difference of latitude and departure, I discovered .... that some error had been contracted in taking the dimensions. Now it is required to compute the area of this enclosure, on the *most probable supposition* of this error."

BOWDITCH's solution depends on several "principles" or hypotheses, the chief of which is "that in measuring the lengths of any lines the errors would probably be in proportion to their lengths." No principles of the Theory of Probability are employed except such as are by common sense implied. His solution coincides with that given by the Method of Least Squares.

This Prize Question undoubtedly led to the following 'Research' by ADRAIN, the Editor of *The Analyst*.

1808 ADRAIN. 'Research concerning the probabilities of the errors which happen in making observations.' *The Analyst or Math. Museum*, Vol. I, pp. 93-109.

This paper seems to have been unknown to mathematicians until 1871 when it was partly reprinted in *Amer. Jour. Sci.*, see 1871 ABBE. It is of great historical interest as containing the first deduction of the law of facility of error

$$\varphi(x) = ce^{-h^2x^2}$$

$\varphi(x)$  being the probability of any error  $x$ , and  $c$  and  $h$  constants depending upon the precision of the measurement. The term "Least Squares" is not used, and ADRAIN seems to have been entirely unacquainted with LEGENDRE's writings.

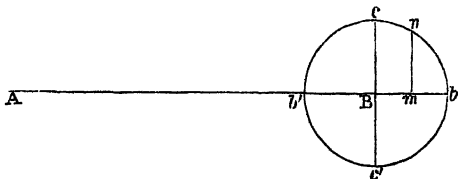
ADRAIN gives two deductions of this law. The first, occupying pages 93-'15 has been reprinted as noted above and need not here be repeated. It depends upon the "self-evident principle" that the true errors of measured quantities are proportional to the quantities them-



selves. The arbitrary nature of this assumption is shown by GLAISHER, *Mem. Astron. Soc. Lond.*, 1872, Vol. XXXIX, pp. 75-81, where the proof is analyzed and regarded as "very slight and inconclusive."

The second proof occupies pages 96-97, and not having been alluded to in the reprint noted above, I give it in ADRAIN's own words as *The Analyst* is quite rare:

"Suppose that the length and bearing of  $AB$  are to be measured; and that the little equal straight lines  $Bb$ ,  $Bc$  are the equal probable errors, the one  $Bb=Bb'$  of the length of  $AB$ , and the other  $Bc=Bc'$  (perpendicular to the former) of the angle at  $A$ , when measured on a circular arc to the radius  $AB$ : and let the question be to find such a curve passing through the four points  $b$ ,  $c$ ,  $b'$ ,  $c'$ , which are equally distant from  $B$ , that, supposing the measurement to commence at  $A$ , the probability of terminating on any point of the curve may be the same as the probability of terminating on any one of the four points  $b$ ,  $c$ ,  $b'$ ,  $c'$ ."



Then follows trivial reasoning which ends by concluding that "the curve must be the simplest possible" and "must consequently be the circumference of a circle having its centre in  $B$ ." This established, the proof is the following:

"Now let us investigate the probability of the error  $Bm=x$ , and of  $mn=y$ . Let  $X$  and  $Y$  be two similar functions of  $x$  and  $y$  denoting those probabilities,  $X'$ ,  $Y'$ , their logarithms, then  $X \times Y = \text{constant}$ , or  $X' + Y' = \text{constant}$ , and therefore  $X'' + Y'' = 0$ , or  $X''x + Y''y = 0$ , whence  $X''x = -Y''y$ . But  $x^2 + y^2 = r^2 = Bb^2$ , therefore  $x\dot{x} = -y\dot{y}$ , by which dividing  $X''x = -Y''y$ , we have  $\frac{X''}{x} = \frac{Y''}{y}$ ; and therefore, by a fundamental principle of similar functions, the similar functions  $\frac{X''}{x}$  and  $\frac{Y''}{y}$  must be each a constant quantity: put

then  $\frac{X''}{x} = n$ , and we have  $X''x = nx$ , that is  $X' = nx$ , and the

fluent is  $X' = c + \frac{nx^2}{2}$ ; in like manner we find  $Y' = c + \frac{ny^2}{2}$  and

therefore the probabilities themselves are  $e^{c + \frac{nx^2}{2}}$  and  $e^{c + \frac{ny^2}{2}}$ , in which  $n$  ought to be negative, for the probability of  $x$  grows less as  $x$  grows greater."

I have seen no allusion to this proof by any subsequent writer. It is essentially the same as given in 1850 by HERSCHEL and usually called HERSCHEL's proof. I regard it as defective in taking " $X \times Y = \text{constant}$ ," or in considering the probabilities of the  $x$  and  $y$  deviations as independent. See 1850 ELLIS. See BOOLE's *Finite Differences* (Cambridge, 1860), pp. 228-229.

In his first proof ADRAIN had found for the probability of the error  $x$  in the observed value  $a$  the expression  $e^{c + \frac{mx^2}{2a}}$ , and had shown that the most probable values of the observed quantities  $a, b, c, \dots$  whose errors are  $x, y, z, \dots$  must satisfy the condition

$$\frac{x^2}{a} + \frac{y^2}{b} + \frac{z^2}{c} + \dots = \text{a minimum.}$$

This principle he applies to four problems; the first showing that the arithmetical mean is a particular case of the method, the second to determine the most probable position of an observed point in space, which is shown to be "precisely in the centre of gravity of all the given points;" the third "to correct the dead reckoning at sea," and the fourth "to correct a survey."

As remarked by ABBE "we must credit Dr. ADRAIN with the independent invention and application of the most valuable arithmetical process that has been invoked to aid the progress of the exact sciences."—*Amer. Jour. Sci.*, 1871, Vol. I, p. 415.

1809 GAUSS. 'Determinatio orbitæ observationibus quocunque maxime satisfaciendis.' *Theoria motus corporum coelestium*.... (Hamburgi, 4to). Lib. II, Sect. III, pp. 205–224. —French translation, see 1855 BERTRAND. —English translation by DAVIS (Boston, 1858, 4to), pp. 249–273. —German trans. by HAASE (Hannover, 1865).

That demonstration of the Method of Least Squares usually called GAUSS's proof or GAUSS's first proof is here presented. Assuming that the arithmetical mean of direct observations is the most probable value of the measured quantity, it deduces that the law of facility of error is given by

$$\varphi(x) = ce^{-h^2x^2}$$

from which the principle of Least Squares at once follows. This proof has been adopted by the majority of books on the subject; see for instance 1832 ENCKE, 1857 DIENGER, 1858 RITTER, 1864 CHAUVENET, 1867 HANSEN and MERRIMAN's *Elements of the Method of Least Squares* (London, 1877, 8vo).

The demonstration as given by GAUSS contains three defects. 1. It is not recognized that the probability of a definite error  $x$ , is an infinitesimal; this is avoided by some later writers. 2. The distinction between *true errors* and *residuals* (or calculated errors) is not sharply drawn; according to GAUSS's reasoning the law  $\varphi(x) = ce^{-h^2x^2}$  is not strictly a "law of facility of error" but only a law of distribution of residuals. 3. The rule of the arithmetical mean is assumed. For critical analyses of this proof see below, 1843 REUSCHLE, 1844 ELLIS and 1872 GLAISHER.

Practical features of the method,—the formation of normal equations and the determination of weights and degrees of precision are also discussed in the Section and hints are given regarding its use in astronomy. On page 221 is an attempt to justify the principle of

Least Squares on the ground that any other process would lead to impracticable calculations.

I quote a historical remark on page 221: "Ceterum principium nostrum, quo jam inde ab anno 1795 usi sumus, nuper etiam a clar. LEGENDEE in opere *Nouvelles méthodes ... comètes*, 1806 prolatum est. ...."

1810 BESSEL. *Untersuchungen über die scheinbare und wahre Bahn der grossen Cometen von 1807*. Königsberg, 4to.

The Method of Least Squares is used in determining the orbit and is called "den *moindres quarrés*." See *Zach's Monatl. Corres.*, 1810, Vol. XXII, pp. 205-212.

1810 LAPLACE. 'Mémoire sur les approximations des formules qui sont fonctions de très-grands nombres, et sur leur application aux probabilités.' *Mém. Inst. France* for 1809, pp. 353-415, 559-565.

Pages 383-389 and 559-565 are devoted to the Theory of Errors, and the principle of Least Squares is proved "lorsque les résultats entre lesquels on doit prendre un milieu, sont donnés chacun par un très-grand nombre d'observations, quelles que soient d'ailleurs les lois de facilité des erreurs de ces observations."

The matter of these pages is reproduced in the *Théorie analytique des Probabilités*, pp. 329-335, 340-342; see below under 1812 for remarks concerning the proof. See *Bull. Soc. Philom. Paris*, 1810, Vol. II, pp. 132-136 for an account of the contents of the memoir.

1811 GAUSS. 'Disquisito de elementis ellipticis Palladis ex oppositionibus 1803, 1804, 1805, 1807, 1808, 1809.' *Comment. Soc. Göttingen*, Vol. I, 26 pp. —French translation, see 1855 BERTRAND.

Twelve equations involving six unknown corrections to the elements of the orbit are solved by the Method of Least Squares. We here find for the first time the notation

$$[ab] = a' b' + a'' b'' + a''' b''' + \dots$$

and also the algorithm for the solution of normal equations by successive substitution, since universally followed in lengthy computations.

A partial translation of the above with comments is given by ZACH in the *Monatl. Corres.*, 1811, Vol. XXIV, pp. 449-465.

1811 LAPLACE. 'Du milieu qu'il faut choisir entre les résultats des observations.' *Mém. Inst. France* for 1810, Pt. I, pp. 317-347.

Contains "the theory of errors substantially coincident with so much of the same theory as we find in pages 314-328 and 340-342 of the *Théorie... des Prob.*" —TODHUNTER, *History of Probability*, p. 490. See below 1812.

An account of the contents of this memoir, with historical remarks on the subject of Least Squares, is given by DELAMBRE, *Bull. Soc. Philom. Paris*, 1811, Vol. II, pp. 262-266, an English translation of which is in *Tilloch's Phil. Mag.*, 1812, Vol. XXXIX, pp. 240-244.

1811 LAPLACE. 'Du milieu qu'il faut choisir entre les résultats d'un grand nombre d'observations.' *Connaissance des Temps* for 1813, pp. 213-223. —German translation in *Zach's Monatl. Corres.*, 1812, Vol. XXV, pp. 105-120.

Contains matter which is reproduced in the *Théorie...des Prob.*, 1812, pp. 322-329.

1812 LAPLACE. '*Théorie analytique des Probabilités.*' Paris, 4to. pp. 464. —Third edition, 1820, 4to, pp. cxlii, 506, with Introduction and three Supplements (see 1814, 1815, 1818, 1820). —Fourth edition (Vol. VII of *Oeuvres de Laplace*) Paris, 1847, 4to, pp. cxcv, 691.

"... the greater part of the *Théorie des Probabilités* is a reprint of papers in the Memoirs of the Academy, which appear to contain the contents of the first papers on which he set down his processes. These with preliminary chapters, descriptive not of what follows, but of the general methods which he drew from the following parts, make up the whole work."—DE MORGAN, *Theory of Probabilities in Encyc. Metrop.*, p. 453. It "is by very much the most difficult mathematical work we have met with."—*Ibid.*, p. 418. TODHUNTER in his *History of Probability*, p. 560, ELLIS (1844) and other writers have also testified to the abstruseness of LAPLACE's methods.

The Method of Least Squares is developed in Chap. IV, (pages 304-348) of the second part of the work. The analysis only extends to the case of two unknown quantities or elements, and the number of observations is required to be very large or infinite. Under these restrictions the Method is shown to give most advantageous results, whatever be the law of facility of error provided only that positive and negative errors are equally probable. LAPLACE's definition of *most advantageous results* is the following: "... si l'on multiplie les erreurs possibles d'un élément par leurs probabilités respectives, le système le plus avantageux sera celui dans lequel la somme de ces produits tous pris positivement, est un *minimum*." The results thus obtained are not necessarily the *most probable*.

In the concluding paragraph of Chap. IV and in the opening pages of the First Supplement (see 1815), LAPLACE has given a general account of his method of analysis. These remarks and the table of contents at the end of the volume, give a much clearer idea of the steps of the demonstration than does Chap. IV itself. The principal objection against the validity of the proof is that it requires an infinite or very large number of observations. With this requirement, however, GAUSS's proof of 1809 becomes perfectly logical and the results are the *most probable*, not merely *most advantageous*.

LAPLACE's proof has been greatly improved by subsequent writers. ELLIS in 1844 extended it to any number of unknown quantities, TODDUNTER in his *History of Probability*, pp. 560-588 supplied a valuable commentary, and GLAISHER in 1872 presented it in a clear and simple form. See also below, 1824 POISSON, 1847 DEMORGAN, 1852 BIENAYMÉ, 1861 AIRY, 1873 LAURENT and 1875 DIENGER.

On pages 318-319 is given what is sometimes called LAPLACE's second proof of the Method of Least Squares. This depends on the definition that "la valeur moyenne de l'erreur à craindre en plus" should be a minimum. The reasoning is similar to GAUSS's proof of 1823; see ELLIS's and GLAISHER's papers quoted below under 1844 and 1872.

[1813] PLANA. Sur divers problèmes de probabilité. *Mém. Acad. Turin* for 1811-12, Vol. XX, pp. 355-408.

1814 CACHY. Mémoire sur le système de valeurs qu'il faut attribuer à divers Éléments, déterminées par un grand nombre d'observations. [Paris, Lith. MS.]

Probably the same as his memoir of 1831.

1814 LAPLACE. '*Essai philosophique sur les probabilités.*' Paris, 4to. —Sixth edition, Paris, 1840, 8vo, pp. 274. —Introduction to second edition of *Théorie... des Prob.*, pp. cvi; to third edition, pp. cxlii; to fourth edition, pp. v-clxix.

Near the end are some remarks concerning the history of the Theory of Errors of observation, and descriptive of LAPLACE's processes.

1814 LEGENDRE. '*Méthode des moindres carrés, pour trouver le milieu le plus probable entre les résultats de différentes observations.*' *Mém. Inst. France* for 1810, Pt. II, pp. 149-154.

Pages 72-75 of the *Nouvelles méthodes...* 1805, are here quoted and reference made to the practical applications of the method given in that work, in order to call attention to LEGENDRE's priority of publication.

1815 BESSEL. '*Ueber den Ort des Polarsterns.*' *Berlin. Astron. Jahrb.* for 1818, pp. 233-240.

We here find the first mention of *probable error*. After giving 48 observations on the right ascension of Polaris whose arithmetical mean is  $55^m 48^s.5104$ , BESSEL says: "Der wahrscheinliche Fehler einer einzelnen Beobachtung ist, nach den wirklichen vorkommenden Fehlern zu urtheilen  $=1^s.067$ , und daher der wahrscheinliche Fehler des Endresultats  $=0^s.154$ . Die Grund dieser Schätzung des wahrscheinlichen Fehlers, beruhen auf der von GAUSS gegebenen Entwicklung der Wahrscheinlichkeit, einen Fehler von gegebener

Grösse zu begehen; ihre Mittheilung muss ich bis auf eine andere Gelegenheit versparen." See 1816 BESSEL, and also page 196 of the memoir 1816 GAUSS.

1815 LAPLACE. 'Sur l'application du calcul des probabilités à la philosophie naturelle.' *Connaissance des Temps* for 1818, pp. 361-381. —First Supplement to third edition of *Théorie...des Prob.* (Paris, 1820, 4to), pp. 3-26.

This is devoted partly to a general description of LAPLACE'S proof of the Method of Least Squares, and partly to the discussion of the probability of results obtained by that method; a numerical example illustrates the use of his formulæ. See TODHUNTER, *Hist. of Probability*, p. 610; also see 1869 TODHUNTER.

1816 BEECK-CALKOEN. Over de Theorie der Gemiddelde Waardij. *Verhandl. Nederland. Inst.*, Vol. II, pp. 1-19.

Treats of LAPLACE'S method of adjustment of 1792.

1816 BESSEL. 'Untersuchungen über die Bahn des OLBERSschen Kometen.' *Abhandl. Akad. Berlin* for 1812-13, pp. 117-160 of the math. section.

BESSEL defines the *probable error* as follows: "Ich verstehe unter dieser Benennung die Grenze, die eine Anzahl kleinerer Fehler von einer *gleichen* Anzahl grösserer trennt, so dass es wahrscheinlicher ist, eine Beobachtung innerhalb jeder *weiteren* Grenze von der Wahrheit abirren zu sehen, als ausserhalb derselben." If we designate by  $\frac{\sum x}{n}$  the mean of the errors all taken positively, by  $\frac{\sum x^2}{n}$  the mean of the squares of those errors, and by  $r$  the probable error of a single observation, his demonstration shows that

$$r = 0.8453 \frac{\sum x}{n} \quad \text{or} \quad r = 0.6745 \sqrt{\frac{\sum x^2}{n}}.$$

BESSEL does not distinguish between true errors and residuals. These formulæ he uses in finding the probable errors of the elements of the orbits, which are deduced by the help of the Method of Least Squares.

1816 GAUSS. 'Bestimmung der Genauigkeit der Beobachtungen.' *Zeitschr. f. Astron. u. ver. Wiss.*, Vol. I, pp. 185-196. —Also *Gauss Werke*, Vol. IV (Göttingen, 1873, 4to), pp. 109-117. —See 1855 BERTRAND.

This memoir gives three methods for finding the probable error from given observations. The first, which is that usually presented in text-books, finds that  $r$  the probable error of an observation of the weight unity, is given (most probably) by

$$r = 0.6744897 \sqrt{\frac{\sum x^2}{n}},$$

$\sum x^2$  being the sum of the squares of the errors and  $n$  the number of observations, and that it is an even wager that the true value of  $r$  lies between

$$\frac{0.6744897 \sqrt{\frac{\sum x^2}{n}}}{1 - \frac{0.4769363}{\sqrt{n}}} \quad \text{and} \quad \frac{0.6744897 \sqrt{\frac{\sum x^2}{n}}}{1 + \frac{0.4769363}{\sqrt{n}}}$$

In the second method the most probable value of the sum  $\sum x^m$  is discussed and formulæ for probable error found when  $m$  has the values 1, 2, 3, 4, 5 and 6. The second of these, which agrees with the one given above, is shown to be the best. The third method leads to a different and less accurate formula.

Nothing in the investigation shows whether  $\sum x^2$  is the sum of the squares of the *true* or of the *computed* errors. By later writers it has been generally taken as referring to the former. See 1816 BESSEL, 1819 YOUNG, 1823 GAUSS, 1856 PETERS, 1866 BÖRSCH.

1818 ADRAIN. 'Investigation of the Figure of the Earth and of the Gravity in different Latitudes.' *Trans. Amer. Phil. Soc.*, Vol. I, pp. 119-135.

A formula for the length of the seconds pendulum is determined by the Method of Least Squares. ADRAIN alludes to the process as having been discovered by himself in 1808. See *Amer. Jour. Sci.*, 1871, Vol. I, p. 415, and *Mem. Astron. Soc. Lond.*, 1872, Vol. XXXIX, p. 78.

1818 BESSEL. '*Fundamenta astronomiæ pro anno MDCCCLV deducta ex observationibus viri incomparabilis JAMES BRADLEY in specula astronomia Grenovicensi per annos 1750-1762 institutis.*' Regiomonti, folio, pp. 325.

In pages 18-21 results of the computations of the mean and probable errors of the declination and right ascension of certain stars as deduced from the observations are given. Three sets of measurements, two of 300 and one of 470, are investigated as a test of the exponential law  $\varphi(x) = \frac{h}{\sqrt{\pi}} e^{-h^2 x^2}$ , the theoretical number of errors between given limits being computed from KRAMP's tables and compared with the actual number of residuals. A close agreement was found, and this may perhaps be called a practical proof of the principle of Least Squares.

Tables of logarithms of  $e^{x^2} \int_0^\infty e^{-t^2} dt$  are given; *regula minimorum quadratorum* is several times applied; and in pages 116-123

methods are given for finding probable errors of quantities indirectly observed.

1818 CAUCHY. Sur la méthode d'erreurs d'un grand nombre d'observations. [Paris], 4to.

1818 LAPLACE. 'Application du calcul des probabilités aux opérations géodésiques.' *Connaiss. des Temps* for 1820, pp. 422-440.

The matter of this article is reproduced in pages 8-25 of the Second Supplement to the third edition of the *Théorie des . . . Prob.* For abstract see *Annal. Chem. et Phys.* 1817, Vol. V, pp. 351-356; also *Zeitschr. für Astron.*, Vol. V, pp. 1-9.

1818 LAPLACE. 'Deuxième supplément à la Théorie Analytique des Probabilités.' Paris, 4to, pp. 50. —Fourth edition of *Théorie . . .*, pp. 569-623.

"LAPLACE shows how the knowledge obtained from measuring a base of verification may be used to correct the values of the elements of the triangles of a survey . . . . LAPLACE explains a method of treating observations which he calls the *method of situation* and which he considers may in some cases claim to be preferable to the *most advantageous method* explained in his fourth chapter."—TOMHUNTER, *History of Probability*, pp. 611-612.

1818 LITTELOW. 'Ueber die gerade Aufsteigung der vornehmsten Fixsterne.' *Zeitschr. f. Astron.*, Vol. VI, pp. 1-26.

The theory of Least Squares and probable errors is used.

1818 LINDENAU. 'Versuch einer Bestimmung der wahrscheinlichsten Bahn des Cometen von 1680, mit Rücksicht auf die planetarischen Störungen während der Dauer seiner Sichtbarkeit.' *Zeitschr. f. Astron.*, Vol. VI, pp. 27-120, 129-208.

The elements and their probable errors are found by the help of GAUSS's method of elimination.

1818 PLANA. 'Allgemeine Formel um nach der Methode der kleinsten Quadrate die Verbesserungen von 6 Elemente zu berechnen und zugleich das jeder derselben zukommenden Gewicht zu bestimmen.' *Zeitschr. f. Astron.*, Vol. VI, pp. 249-264.

1819 LAPLACE. 'Application du calcul des probabilités aux opérations géodésiques de la méridienne de France.' *Annal. Chem. et Phys.*, vol. XII, pp. 37-41. —*Connaiss. des Temps*, for 1822, pp. 346-348. —Trans. in *Tilloch's Phil. Mag.*, 1821, Vol. LVIII, pp. 133-136.

A discussion of the length of the meridian between Perpignan and Formentera, two points distant about 460000 metres and joined by



26 triangles. LAPLACE shows that the probable error of the computed distance is 8.194 metres. The investigation is reproduced in the Third Supplement (1820), pp. 3-7.

1819 LAPLACE. 'Mémoire sur l'application du calcul des probabilités aux observations, et spécialement aux opérations du nivellement.' *Annal. Chem. et Phys.*, Vol. XII, pp. 337-341.

On the results of a discussion of the probability of errors in the computed elevation of Paris. The discussion itself is given in the Third Supplement (1820), pp. 16-28.

1819 PAUCKER. 'Ueber die Anwendung der Methode der kleinsten Quadratsumme auf physikalischen Beobachtungen.' Mitau, 4to, pp. 32.

Published as a Gymnasium "Programm." It contains an application of the Method of Least Squares to the determination of empirical formulæ for the expansion of fluids, the specific gravity of water, and the elasticity of steam. See 1825 MUNCKE.

1819 WALBECK. *Dissertatio de forma et magnitudine telluris, ex dimensis arcibus meridiani definiendis.* Åbo, 8vo.

The first discussion of measurements of *several* arcs of meridians by the Method of Least Squares.

1819 YOUNG. Remarks on the probabilities of error in physical observations, and on the density of the earth, considered, especially with regard to the reduction of experiments on the pendulum.' *Phil. Trans. Lond.* for 1819, pp. 70-95.

Pages 70-83 are devoted to the Theory of Errors. Besides many interesting remarks it contains a method for finding probable errors, supposing that the probabilities of the several errors are proportional to the terms of the series  $(1+l)^m$ ,  $m$  being an even number. His result for the probable error of the mean of  $n$  observations is

$$R = 0.85 \frac{\sum x}{n\sqrt{n}}$$

in which  $\frac{\sum x}{n}$  denotes "the mean of all the actual errors." YOUNG refers to BESSEL, GAUSS, &c., as having used only the sum of the squares of the errors in determining the probable error, and regards his method as more accurate. See 1816.

1820 BESSEL. 'Bestimmung der geraden Aufsteigungen der 36 MASKELYNESchen Fundamental-Sterne für 1815, auf Königsberger Beobachtungen gegründet.' *Abhandl. Akad. Berlin* for 1818-19, pp. 19-36 of the mathematical part. — *Abhandl. von Bessel* (Leipzig, 1875, 4to), Vol. II, pp. 238-245.

Contains discussions on the probable errors of the observations. See also *Abhandl. Akad. Berlin* for 1825, pp. 23-35.

[1820] LAPLACE. '*Troisième Supplément à la Théorie analytique des Probabilités.*' Paris, 4to, pp. 36. — Fourth edition of the *Théorie* . . . . , pp. 624-660.

See 1819. At the end of the Supplement is an investigation of the general case of "observations assujéties à plusieurs sources d'erreurs." See TODHUNTER, *Hist. of Probability*, p. 612.

[1820] LEGENDRE. '*Nouvelles méthodes pour la détermination de l'orbite des comètes. Second supplément.*' Paris, 4to, pp. 80.

In pages 3 and 4 LEGENDRE says: "J'ai donné le premier deux méthodes sûres pour obtenir la solution à la fois la plus simple et la plus exacte, savoir: la méthode des corrections indéterminées . . . . , et la méthode des moindres carrés qui paraissait alors pour la première fois." See 1789 and 1805.

Pages 79-80 contain a "Note par M \* \* \*" in which the honor of the discovery of the Method of Least Squares is claimed for LEGENDRE on the ground of priority of publication, and in which GAUSS although not mentioned by name receives several sharp hits.

1821 SVANBERG. Om roterande systemers principal-axlar och sannolikaste medel-resultatet af gifna observationer. *Vetensk. Akad. Handl. Stockholm* for 1821, pp. 388-408.

1821 ———. 'Dissertation sur la recherche du milieu le plus probable, entre les résultats de plusieurs observations ou expériences.' *Gergonne's Annales de Math.*, Vol. XII, pp. 181-204.

This paper discusses at some length the different methods which may be imagined for finding a mean value, and concludes that the problem is indeterminate because it is impossible to render it independent of the law of facility of error, concerning which there may be "une infinité d'hypothèses." It tries to determine a mean, first supposing that the probability of each given measurement is inversely proportional to the error committed and secondly supposing that that probability is inversely proportional to the square of the error, and concludes that the arithmetical mean can only be used when the observations differ but slightly among themselves.

The paper ends by offering a method for the correction of the arithmetical mean, which amounts to this: First find the average of the measured quantities and compute the residuals. Then take the reciprocal of each residual as the weight of its corresponding observation and find the mean of these weighted observations. Or as weights the reciprocals of the squares of the residuals may be taken. The new mean gives new residuals from which a second approximation may be made, and so on. In a note at the end, the editor (GERGONNE) suggests that this approximation will always tend to one of the given measurements as the mean.

1822 ENCKE. 'Die Entfernung der Sonne von der Erde aus dem Venusdurchgange von 1761.' Gotha, 8vo, pp. 179. —Part II entitled 'Der Venusdurchgang von 1769 . . . ' Gotha, 1824, 8vo, pp. 112.

The Method of Least Squares is applied to the reduction of 149 observations from the transit of 1761 and 106 from that of 1769, and to the determination of probable errors. The most probable distance of the sun from the earth is found to be 20666800 German geographical miles with the probable error of 89150 miles.

1822 GAUSS. 'Anwendung der Wahrscheinlichkeitsrechnung auf eine Aufgabe der practischen Geometrie.' *Astronomische Nachrichten*, Vol. I, col. 81–88. —See 1855 BERTRAND.

The problem is: To determine the position of a point from horizontal angles taken at that point between other points whose position is exactly known. A numerical example is given in which the number of known points is five and the number of angles is six. This is often called PORHÉNOT'S problem; see 1840 GERLING, 1866 SCHOTT.

1823 GAUSS. 'Theoria combinationis observationum erroribus minimis obnoxia.' *Comment. Soc. Göttingen*, Vol. V, pp. 33–90. —Also *Gauss Werke*, Vol. IV (Göttingen, 1873, 4to), pp. 1–53. —French trans. see 1855 BERTRAND.

This memoir contains GAUSS'S second Proof of the Method of Least Squares. The following quotation from pages 37–38 shows the hypothesis upon which the proof is based: "... integrale  $\int_{-\infty}^{+\infty} \varphi(x) dx$  ab  $x = -\infty$  usque ad  $x = +\infty$  extensum (seu valor medius quadrati  $x^2$ ) aptissimum videtur ad incertitudinem observationum in genere definiendam et dimetiendam, ita ut e duobus observationum systematibus, quæ quoad errorum facilitatem inter se differunt, eæ præcisiōne prestare censeantur, in quibus integrale  $\int_{-\infty}^{+\infty} \varphi(x) dx$  valorem minorem obtinet." GAUSS does indeed recognize and point out that this is only an arbitrary convention, but he justifies himself in adopting it on the ground that the definition of most advantageous results must be arbitrary, since the question is in its very nature indefinite, and that his definition leads to simple operations. The values of the unknown quantities found by his method he calls "valores maxime plausibiles."

GAUSS'S method leads to the rule of Least Squares, whatever be the number of observations or whatever be the law of facility of error provided only that positive and negative errors are equally probable. For analyses of his proof see 1844 ELLIS and 1872 GLAISHER, the former regarding it as valid and the latter as unsatisfactory. In my opinion it is but little more than a begging of the question to assume that the mean of the squares of the errors is a measure of precision. See below 1825 IVORY, 1847 GALLOWAY and 1872 HELMERT.

The memoir contains an extended presentation of the practical features of the method and in this respect is of great value. The algo-

rithm for the solution of normal equations by the method of substitution (1816), the determination of weights and of formulas for mean error occupy the second part of the memoir. The value of the mean

error of an observation of the weight unity being  $m = \sqrt{\frac{\sum x^2}{n}}$ , GAUSS

takes  $\sum x^2$  as referring to the true errors, and determines  $m = \sqrt{\frac{\sum v^2}{n-q}}$

as a practical formula,  $\sum v^2$  referring to the computed residuals,  $n$  being the number of observations and  $q$  that of the unknown quantities: the investigation however is not very clear. See 1816 BESSEL and GAUSS, and 1856 BIENAYMÉ.

For GAUSS's own account of the contents of these memoirs see the *Göttingische gelehrte Anzeigen*, Feb. 26, 1821 and Feb. 24, 1823. These reviews are reprinted in Vol. IV. of *Gauss Werke*, pp. 95-104. GAUSS here states that in the year 1797 he found that the determination of the *most probable* values of observed quantities was impossible, unless the law of facility of error was known; and that since 1801 he had used the Method of Least Squares almost daily. See 1830 RIESE.

1824 BERLIN. *Explanatio methodi quadratorum minimorum*. Lundæ, 4to.

1824 FOURIER. 'Règle usuelle pour la recherche des résultats moyens d'un grand nombre d'observations.' *Férussac's Bull. Sci. Math.*, Vol. II, pp. 88-90.

The rule given is expressed by the formula

$$m = 0.4769 \frac{\sqrt{\frac{\sum a^2}{n} - \left(\frac{\sum a}{n}\right)^2}}{\sqrt{2n}}$$

$a_1, a_2, a_3, \dots$  being the results of the  $n$  observations.

1824 POISSON. 'Sur la probabilité des résultats moyens des observations.' *Connaiss. des Temps* for 1827, pp. 273-302; for 1832, pp. 3-22.

These memoirs are a commentary on LAPLACE's fourth Chapter (1812) and seem to form a kind of translation which POISSON made of LAPLACE's investigations for his own satisfaction. A large part of the memoirs are reproduced in his *Recherches* . . . , see 1837. See also 1830 HAUBER, 1847 GALLOWAY and TODHUNTER's *History of Probability*, pp. 560-588. See *Jahrb. Chem. u. Phys.*, Vol. IV, pp. 38-42.

"POISSON confines himself to the case in which *one* element is to be determined from a large number of observations, but he treats this case in a more general manner than LAPLACE had done. LAPLACE had assumed that positive and negative errors were equally

likely, and that the law of facility of error is the same at every observation; but POISSON makes neither of these assumptions."—TODHUNTER in *Trans. Camb. Phil. Soc.*, 1869, Vol. XI, p. 219.

1824 PUISSANT. 'Application de la methode la plus avantageuse à la determination de l'aplatissement du sphéroïde osculateur en France, par le comparaison d'un arc de méridien avec un arc de parallèle.' *Férussac's Bull. Sci. Math.*, Vol. I, pp. 271-274. — *Connaiss. des Temps* for 1827, pp. 230-232.

A general statement of the method, which seems to have been elsewhere published in detail.

1825 IVORY. 'On the Method of the Least Squares.' *Tilloch's Phil. Mag.*, Vol. LXV, pp. 3-10, 81-86, 161-168.

This paper contains two attempted proofs of the principle of Least Squares by methods independent of the Theory of Probability. The first, in page 5, rests on a vague analogy with the properties of a lever and is in the words of ELLIS "little more than a *petitio principii* concealed by a metaphor." The second, in pages 6-7, rests on the supposition that "the mean of the sum of the squares of the errors may be taken as a measure of the precision of the observations" which can scarcely be assumed as evident; this is similar to GAUSS's proof of 1823.

Pages 81-86 are devoted to discussing the probability of errors. IVORY makes no distinction between true errors and residuals, and does not recognize that the probability of any definite error must be an infinitesimal. The remaining pages attempt to show that the Method of Least Squares cannot give the most advantageous or probable results unless the law of facility of error is  $\varphi(x) = ce^{-h^2x^2}$ , and that LAPLACE's demonstration "whatever merit it may have in other respects is neither more or less general than the other solutions of the problem."

These two proofs are examined and exposed by ELLIS in 1844, and the second proof with the criticisms on LAPLACE are analyzed by GLAISHER in 1872. See also 1851 HOSSARD.

1825 MUNCKE. 'Beobachtung.' Art. in *Gehler's Physikalisches Wörterbuch*, second ed. Vol. I, pp. 884-912.

Contains matter from 1823 GAUSS and 1819 PAUCKER.

1826 GAUSS. 'Chronometrische Längenbestimmung.' *Astron. Nachr.*, Vol. V, col. 227-240, 245-248. —See also 1855 BERTRAND.

The Method of Least Squares is used and formulæ for finding mean errors of the results given.

1826 [FOURIER]. Recherches statistiques sur la ville de Paris et le département de la Seine [par le Compté CHABROL-DE-VOLVIC]. Paris, 4to, Vol. III, in 1826, Vol. IV in 1829.

These volumes contain investigations by FOURIER on weights, probable errors, etc. See note by DEMORGAN in *Lond. Assur. Mag.*, Vol. XIV, p. 89.

1826 IVORY. 'On the Method of the Least Squares.' *Tilloch's Phil. Mag.*, Vol. LXVIII, pp. 161-165.

Contains IVORY's third attempted proof of the Method, which is still more absurd than those of 1825. See ELLIS's analysis in his paper of 1844. See also below, 1830 FRANCOEUR.

1827 ROSENBERGER. 'Ueber die, auf Veranstaltung der französischen Academie, während der Jahre 1736 und 1737 im Schweden vorgenommene Gradmessung.' *Astron. Nachr.*, Vol. VI, col. 1-32.

An application of a method, communicated to the author by BESSEL, for the adjustment of geodetic triangulations by the use of Least Squares. See 1831 HANSEN. See *Abhandl. von Bessel* (Leipzig, 1875), Vol. III, pp. 16-19.

1827 ———. Ueber die Theorie der Zuverlässigkeit der Beobachtungen und Versuche und der von derselben abhängigen Bestimmungen des Mittels aus gegebenen Zahlen. [Berlin].

1828 BESSEL. 'Ueber die Bestimmung des Gesetzes einer periodischen Erscheinung.' *Astron. Nachr.*, Vol. VI, col. 333-348. — *Abhandl. von Bessel* (Leipzig, 1875, 4to), Vol. II, pp. 364-372.

Proposes the periodic function since so much used for discussing recurring phenomena, and illustrates its application to the determination of empirical formulæ. See 1864 SCHOTT.

1828 GAUSS. 'Supplementum theoriæ combinationis observationum erroribus minimis obnoxia.' *Comment. Soc. Göttingen*, Vol. VI, pp. 57-98. —Also *Gauss Werke*, Vol. IV, pp. 57-93. —French trans. see 1855 BERTRAND.

This memoir discusses a method for the combination of observations when the observed quantities are not expressed as explicit functions of the unknown quantities to be determined; and when the problem furnishes rigorous equations of condition which the determined values of the unknown quantities must exactly satisfy. The *method of correlatives* for the adjustment of such conditioned observations is given and an algorithm presented for its use. A numerical example involving twenty-four observations subject to thirteen conditions illustrates the use of the formulæ. See the *Gött. gelehrte Anzeigen*, Sept. 25,

1826, or *Gauss Werke*, Vol. IV, pp. 104–108 for GAUSS's own account of the contents of the memoir. See also 1830 RIESE.

1828 QUETELET. *Instructions populaires sur le calcul des probabilités*, Bruxelles, 18mo.

1830 FRANCOEUR. 'De la composition des formules astronomiques, et de la détermination des constantes; Équations de condition; Méthodes de TOBIE MAYER et des moindres carrés.' *Astronomie pratique* (Paris, 8vo; second ed., 1840), pp. 412–431.

IVORY's proof of 1826 is given as a perfectly valid "démonstration." This is repeated in the second edition.

1830 HANSEN. *Commentatio de gradus præcisionis computatione*. [Gotha, 4to.]

This was first printed "in einem Program, womit die hiesige Sternwarte [at Gotha] des Jubiläum des würdigen OLBERS gefeiert hat." It contained a method for finding the weights of values determined by the Method of Least Squares, which for a small number of unknown quantities is perhaps shorter than that of GAUSS (1823). See *Astron. Nachr.*, Vol. VIII, col. 462–463, and ENCKE in *Berlin Astron. Jahrb.* for 1835, p. 297.

1830 HAUBER. Ueber die Bestimmung der Genauigkeit der Beobachtungen. *Baumgartner's Zeitschr. f. Phys. Math., etc.*, Vol. VII, pp. 286–314.

1830 HAUBER. Verallgemeinerung der Poisson'schen Untersuchungen über die Wahrscheinlichkeit der mittlern Resultate der Beobachtungen in den "Additions à la *Connaissance des Temps* de 1827." *Baumgartner's Zeitschr.*, Vol. VII, pp. 406–429.

1830 HATBER. Theorie der mittleren Werthe. *Baumgartner's Zeitschr.*, Vol. VIII, pp. 25–26, 147–179, 295–315, 443–445; Vol. IX, pp. 302–322; Vol. X, pp. 425–457.

[1830] NÜRNBERGER. Betrachtung über die Methode der kleinsten Quadrate.

1830 POISSON. 'Note sur la probabilité du résultat moyen des observations.' *Férussac's Bull. Sci. Math.*, Vol. XIII, pp. 266–277.

On LAPLACE's method of deducing formulæ for probable errors.

1830 POISSON. 'Mémoire sur la proportion des naissances des filles et des garçons.' *Mém. Acad. Paris*, Vol. IX, pp. 239–308.

The general term of the binomial theorem is shown to take the exponential form  $ce^{-u^2}$ , when the number of terms is indefinitely great: See LAPLACE, *Théorie des . . . Prob.*, Chap. III, and 1837 HAGEN. Formulæ for probability of errors between given limits and for probable errors are also developed. See 1836 POISSON.

1830 RIESE. '[Eine Recension.]' *Jahrb. für wiss. Kritik* for 1830, Pt. I, col. 269-284.

A review of GAUSS's memoirs *Theoria combinationis . . .*, 1823, and *Supplementum theoriæ*. . . , 1827, giving an account of their contents and a popular exposition of the subject.

1831 CAUCHY. 'Mémoire sur le système de valeurs qu'il faut attribuer à divers Éléments, déterminés par un grand nombre d'observations, pour que la plus grande de toutes les erreurs, abstraction faite du signe, devienne un minimum.' *Jour. École Poly.*, Vol. XIII (cahier 20), pp. 175-221.

This was perhaps published about 1814, See *Bull. Soc. Philom. Paris*, for 1824, pp. 92-99. The methods of 1760 BOSCOVICH and 1792 LAPLACE, are particular cases of CAUCHY's solution. See LAPLACE's *Théorie . . . des Prob.*, Chap. IV, Art. 24.

1831 DEGEN. 'Recherches sur la parabole, déterminée par la méthode des moindres carrés et qui représenté le moins défectueusement, qu'il il soit possible, un système quelconque de points donnés dans un plan.' *Mém. Acad. St. Péters. par divers savants*, Vol. I, pp. 13-28.

1831 GRUNERT. 'Berechnung der wahrscheinlichsten Resultate aus gegebenen Beobachtungen. Methode der kleinsten Quadrate.' *Klügel's Mathematisches Wörterbuch*, Vol. V, Art. "Wahrscheinlichkeitsrechnung," pp. 983-1027.

A clear presentation of the Method of Least Squares according to GAUSS, the proof being that of 1809.

1831 HANSEN. 'Darlegung einer neuen Methode, bei Anwendung der Methode der kleinsten Quadrate, die Gewichte der unhekannten Grössen zu berechnen.' *Astron. Nachr.*, Vol. VIII, col. 463-468.

A simplification of GAUSS's method of 1823 for finding weights. Not the same as 1830 HANSEN. See 1832 ENCKE.

1831 HANSEN. 'Ueber die Anwendung der Wahrscheinlichkeitsrechnung auf geodätische Vermessungen im Allgemeinen, und über die MAUPERTUIS'sche Gradmessung.' *Astron. Nachr.*, Vol. IX, col. 189-220, 237-262.



The measurements are discussed by GAUSS's method of correlatives (1828) whose algorithm is given in full, and also by a new method of HANSEN. ROSENBERGER had in 1827 examined the same measurements.

1831 LITTELOW. Bemerkungen zum practischen Gebrauche der Wahrscheinlichkeitsrechnung. *Baumgartner's Zeitschr. f. Phys.*, Vol. IX, pp. 433-449.

1831 PUISSANT. 'Application du calcul des probabilités à la mesure de la precision d'un grand nivellement trigonométrique.' *Mém. Acad. Paris*, Vol. X, pp. 533-547. — *Connaiss. des Temps* for 1834, pp. 3-17.

A modification of the method of LAPLACE's Third Supplement (1820), illustrated by a practical example.

1832 ENCKE. 'Ueber die Begründung der Methode der kleinsten Quadrate.' *Abhandl. Akad. Berlin* for 1831, pp. 73-78 of the mathematical part.

After brief notices of five proofs of the Method of Least Squares, ENCKE gives the preference to GAUSS's of 1809. To establish this more rigidly he offers a demonstration to show that for direct observations the rule of the arithmetical mean gives the most probable result. This demonstration (in my opinion not a rigorous one) has been followed by many subsequent writers. It is repeated by ENCKE in the article quoted next below, and is particularly stated with confidence by CHAUVENET in 1864. For criticisms see 1843 REUSCHLE and 1872 GLAISHER. See also ENCKE's later opinion, below under 1850.

1832 ENCKE. 'Ueber die Methode der kleinsten Quadrate.' *Berlin. Astron. Jahrbuch* for 1834, pp. 249-312; for 1835, pp. 253-320; for 1836, pp. 253-308. —Republished in *Encke's astronomische Abhandlungen* (Berlin, 1866), Vol. I, Nos. xii, xiii, xiv.

These memoirs form a treatise on the Method of Least Squares, from which many text-books have been compiled.

The first memoir contains the proof of 1809 GAUSS, reinforced by ENCKE's attempted demonstration of the validity of the arithmetical mean, the discussion of weight and probable errors, and two tables of the probability integral  $\frac{2}{\sqrt{\pi}} \int_0^x e^{-t^2} dt$ , the first between the limits 0

and  $x$ , and the second between the limits 0 and  $0.476936 \frac{x}{r}$  ( $x$  being any error and  $r$  the probable error). These were computed from KRAMP's tables of 1799 as quoted by BESSEL in 1818. See *Lond. Phil. Mag.*, 1871, Vol. XLII, p. 431, et sq. A translation of this first memoir and a reprint of the tables is given in *Taylor's Scientific Memoirs*, 1841, Vol. II, pp. 317-369.

ENCKE takes  $y=\varphi(x)$  as the equation of the curve expressing the probability of error, and regarding  $x$  and  $y$  as continuous variables recognizes clearly that for a given error  $\varphi(x)$  must be an infinitesimal. But strange to say he deduces

$$\varphi(x) = \frac{h}{\sqrt{\pi}} e^{-h^2 x^2}$$

in which  $h$  is a finite quantity.

The second memoir contains the practical features of the method—GAUSS's algorithm for the solution of normal equations, GAUSS's (1823) and HANSEN's (1830 and 1831) methods of determining weights, etc. The third is devoted to the discussion of conditioned observations. At the time of publication these memoirs must have been of great value to students.

1832 LITTROW. *Die Wahrscheinlichkeitsrechnung und ihre Anwendung auf das wissenschaftliche und practische Leben.* Wien, 8vo.

1832 PUISSANT. 'Deuxième mémoire sur l'application du calcul des probabilités aux mesures géodésiques.' *Mém. Acad. Paris*, Vol. XI, pp. 123–156.

Adjustment of triangulations, determinations of probable errors, etc.

1834 BESSEL. 'Betrachtung über die Methode der Vervielfältigung der Beobachtungen.' *Astron. Nachr.*, Vol. XI, col. 269–290. — *Abhandl. von Bessel* (Leipzig, 1875), Vol. III, pp. 306–317.

This valuable paper deduces rules for the adjustment of angles taken by the method of repetitions, and formulæ for finding their weights and probable errors.

1834 STROOTMAN. *Bevatteijk onderrigt in de Kansrekening, of de leer der waarschijnlijkheden.* Breda, 12mo.

1835 CAUCHY. 'Mémoire sur l'interpolation.' Lith. MS. — Translation in *Lond. Phil. Mag.*, 1836, Vol. VIII, pp. 459–468. — Reprinted in *Liouville's Jour. Math.*, 1837, Vol. II, pp. 193–205; in *Moigno's Leçons de calcul différentiel* (Paris, 1840), pp. 513–526.

When an empirical formula is to be derived from a great number of observation equations, CAUCHY's method may be used as easily, although perhaps with less accuracy than the Method of Least Squares. See below 1853 BIENAYME and CAUCHY, 1842 GRUNERT and 1861 SCHOTT. See an article by BARTLETT in *Amer. Jour. Sci.*, 1862, Vol. XXXIV, pp. 27–33.

1836 POISSON. 'Formules relatives aux probabilités qui dépendent de très grand nombres.' *Comptes Rend. Acad. Paris*, Vol. II, pp. 603–613.

The general term of the binomial  $(p+q)^m$ , in which  $p+q=1$ , is shown to approach the form  $\frac{e^{-u^2}}{\sqrt{2\pi mpq}}$ , as  $m$  indefinitely increases. See 1830 POISSON.

1836 ROUVROY. Ueber die Methode der kleinsten Quadrate. Appendix to his *Mechanik* (Dresden and Leipzig, 8vo).

1837 HAGEN. *Grundzüge der Wahrscheinlichkeits-Rechnung*. Berlin, 8vo. —Second edition, see 1867.

This work contains HAGEN's proof of the Method of Least Squares. It is based upon the following hypothesis: "Der Beobachtungsfehler ist die algebraische Summe einer unendlich grossen Anzahl elementärer Fehler, die alle gleichen Werth haben und eben so leicht positiv, wie negativ sein können." This postulated, the proof consists in finding the general term of the expansion of  $(\frac{1}{2} + \frac{1}{2})^m$ ,  $m$  being indefinitely large. The law of facility of error takes the form  $\varphi(x) = (\pi m)^{-\frac{1}{2}} e^{-\frac{x^2}{m}}$  from which the principle of Least Squares at once follows.

The algebraic work of HAGEN's method had in a somewhat different form been given by LAPLACE in the *Théorie . . . des Probabilités* (1812), p. 301, and in the articles 1830 POISSON and 1836 POISSON. HAGEN's method is more elementary and in connection with his original hypothesis forms, I think, one of the best proofs of the Method of Least Squares.

HAGEN's proof is given in the writings 1849 WITTSTEIN, 1850 ENCKE, 1852 DIENGER, and in a modified form 1846 QUETELET, 1865 TAIT, 1866 NATANI and others. Also see PRICE's *Integral Calculus* (Oxford, 1865), pp. 376-379. A discussion between KUMMELL and MERRIMAN concerning this proof is now (Oct., 1877) going on in the *Jour. Franklin Institute*; see Vol. CIV, pp. 173-187, 270-274, et sq.

1837 POISSON. '*Recherches sur la probabilité des jugemens en matière criminelle et en matière civile, précédées des règles générales du calcul des probabilités.*' Paris, 4to, pp. ix, 415. —German trans. by SCHNUSE called *Lehrbuch der Wahrscheinlichkeitsrechnung*; Braunschweig, 1841, 8vo.

The matter of POISSON's previous memoirs on the law of great numbers is reproduced in Chap. III, and of those on the probability of the mean in Chap. IV.

1838 BESSEL and BAEYER. '*Gradmessung in Ost-Preussen und ihre Verbindung mit preussische und russische Dreiecksketten.*' Berlin, 4to, pp. xiv, 452.

A geodetic work of great value, containing many applications of the Method of Least Squares. See extracts in *Abhandl. von Bessel*, (Leipzig, 1875), Vol. III, pp. 82-138.

1838 BESSEL. 'Untersuchungen über die Wahrscheinlichkeit der Beobachtungsfehler.' *Astron. Nachr.*, Vol. XV, col. 369-404. — *Abhandl. von Bessel* (Leipzig, 1875), Vol. II, pp. 372-391.

"Ich werde nämlich die Entstehungsart der Beobachtungsfehler aus ihren Ursachen, zum Grunde des Folgenden machen. Wenn man aufangs die Fehler einer gewissen Beobachtungsart also aus einer, auf gegebene Art wirkenden Ursache hervorgehend betrachtet, so wird dadurch ihre jedesmalige Grösse  $x$  eine gegebene Function eines Arguments  $\xi$ , welches in derselben Art willkürlich ist, wie das Fallen eines Würfels. Aus dem Ausdrucke  $x = f\xi$  kann aber der Ausdruck  $\varphi(x)$  abgeleitet werden, . . ."

BESSEL seems to use the word *Ursache* in the sense of a source of error. His first investigation is of a case arising in the measurement of angles, where the error  $x$  is related to the *Ursache*  $\xi$  by the law  $x = a \sin \xi$ , every value for  $\xi$  between the limits  $\pm \frac{1}{2}\pi$  being equally possible. The law of facility of error he finds  $\varphi(x) = \pi^{-1}(a^2 - x^2)^{-\frac{1}{2}}$ , and the probable error is 2.568 times greater than by the Method of Least Squares. An example where  $x = a\xi^2$ , which he shows may actually arise, gives also disagreeing results.

In the second part of the investigation we read: "Ich werde nun die Wahrscheinlichkeit eines Fehlers untersuchen, welcher aus der *Zusammenwirkung* mehrerer, von einander unabhängiger Ursachen entsteht," each error so arising being considered as equally likely to be positive or negative. The result of the investigation is that the law of facility of error approximates closely to the exponential form  $\varphi(x) = ce^{-h^2x^2}$ , provided that "viele Ursachen zur Hervorbringen des Beobachtungsfehlers *zusammenwirken*," and "dass unter den, aus den einzelnen Ursachen hervorgehenden mittlern Fehlern, keiner die übrigen beträchtlich übertreffe," and these conditions BESSEL thinks, are present in most observations.

This memoir is very valuable as showing that the exponential law of facility is not to be regarded as an *a priori* rule, free from exception, and as throwing new light on the condition under which it exists. On the whole it may be considered as a new proof of that law and hence of the Method of Least Squares.

1838 BIENAYMÉ. 'Mémoire sur la probabilité des résultats moyens des observations; démonstration directe de la règle de LAPLACE.' *Mém. . . par divers savants*, . . *Acad. Paris*, Vol. V, pp. 513-558.

The rule of LAPLACE here meant is a method for finding the probability of the error of the mean. The opening pages contain some interesting historical remarks, but the investigation itself is very long and tedious and seems to be of little value.

1838 DEMORGAN. 'Essay on Probabilities,' London, 12mo. pp. xviii, 306, xl.

This popular book devotes a chapter to methods of finding weights and estimating probabilities of mean results. It contains tables of the error functions.

1838 DEMORGAN. 'On a Question in the Theory of Probabilities.' *Trans. Camb. Phil. Soc.*, Vol. VI, pp. 423-430.

"The object of this paper is the correction of an oversight made both by LAPLACE and M. POISSON in pages 279 and 209 of their respective works on the Theory of Probabilities."

1838 PUISSANT. 'Sur l'application du calcul des probabilités à la mesure de la précision d'un grand nivellement géodésique indépendant des distances respectives des stations.' *Comptes Rend. Acad. Paris*, Vol. VII, pp. 1132-1135.

The mean errors of the adjusted elevations are deduced.

1839 BIENAYMÉ. Théorème sur la probabilité des résultats moyens des observations. *Procès-Verb. Soc. Philom. Paris* for 1839, pp. 60-65.

1839 HANSEN. 'Auflösung einer allgemeinen Aufgabe aus der Wahrscheinlichkeitsrechnung.' *Astron. Nachr.*, Vol. XVI, col. 9-16, 27-32.

On the determination of the values and weights of observed quantities subject to conditional equations. A particular case of HANSEN's problem is noted below under 1841.

1839 JAHN. *Die Wahrscheinlichkeitsrechnung und ihre Anwendung auf das wissenschaftliche und praktische Leben.* Leipzig, 8vo, pp. 240.

1840 BESSEL. 'Neue Formel von JACOBI, für einen Fall der Anwendung der Methode der kleinsten Quadrate.' *Astron. Nachr.*, Vol. XVII, col. 305-308. — *Abhandl. von Bessel* (Leipzig, 1875), Vol. II, pp. 401-402.

Formulae for solving normal equations containing *three* unknown quantities and determining at the same time the weights. They are regarded by BESSEL as shortening considerably the numerical work required by previous methods. See below 1873 SEELIGER.

1840 BESSEL. 'Ein Hülfsmittel zur Erleichterung der Anwendung der Methode der kleinsten Quadrate.' *Astron. Nachr.*, Vol. XVII, col. 225-230. — *Abhandl. von Bessel*, Vol. II, pp. 398-401.

Computations arising in the formation of normal equations can be shortened by the use of tables of squares of numbers.

1840 BIENAYMÉ. La constance des résultats moyens. *Procès-Verb. Soc. Philom. Paris* for 1840, pp. 19-26.

1840 BIENAYMÉ. Principe des probabilités entièrement nouveau. *Procès-Verb. Soc. Philom. Paris* for 1840, pp. 37-43.

1840 BIENAYMÉ. Quelques propriétés des moyens arithmétiques de puissances de quantités positives. *Procès-Verb. Soc. Philom.* for 1840, pp. 67-70.

1840 BRAVI. *Theorica e practica del probabile*. Bergamo, second edition, 2 vols, 8vo.

1840 CLEMENS. 'Ueber die Methode der kleinsten Quadrate. *Tilsit Gymnasium Programm* for 1839-40, pp. . . . .; for 1848, pp. 1-12.

The first part of this memoir I have not seen. The second discusses the determination of empirical formulæ for periodic observations, the calculation of probable errors and the correction of a field survey.

1840 GERLING. *POTHENOT'sche Aufgabe, in practischer Beziehung dargestellt*. Marburg, 8vo, pp. 32.

Contains mainly the solution of 1822 GAUSS. See 1866 SCHOTT.

1841 BESSEL. 'Ueber einen Fehler in der Berechnung der französischen Gradmessung und seinen Einfluss auf die Bestimmung der Figur der Erde.' *Astron. Nachr.*, Vol. XIX, col. 97-116. — *Abhandl. von Bessel* (Leipzig, 1875), Vol. III, pp. 55-62.

Forty-four observations subject to sixteen conditions are adjusted. The method here employed for the combination of measurements of arcs of meridians has furnished a model for many subsequent investigations.

1841 HANSEN. 'Eine Aufgabe aus der practischen Geodäsie und deren Auflösung.' *Astron. Nachr.*, Vol. XVIII, col. 165-176.

"Die Lage zweier unbekannten Punkte durch Hülfe der Lage zweier bekannten Punkte zu bestimmen, ohne jene von diesen aus zu beobachten."

1841 HÜLSSE. *Ueber die Berechnung von Beobachtungen durch die Methode der kleinsten Quadratsumme*. Leipzig, 4to.

1841 JACOBI. 'De formatione et proprietatibus Determinantium.' *Crelle's Jour. Math.*, Vol. XXII, pp. 285-318.

Near the end of this memoir are remarks concerning the application of determinants to the solution of equations and to the finding of weights in the Method of Least Squares.

1841 QUETELET. Ueber das Gesetz des Quadrats der Temperaturen. *Bull. Akad. München* for 1841, col. 261-263.

1842 FRIES. *Versuch einer Kritik der Principien der Wahrscheinlichkeitsrechnung*. Braunschweig, 8vo.

1842 GRUNERT. 'Ueber CAUCHY's Interpolationsmethode.' *Archiv. Math. u. Phys.*, Vol. II, pp. 41-60.

See 1835 CAUCHY.

1842 LITTRON. 'Theorie der kleinsten Quadrate.' *Gehler's Physikalisches Wörterbuch*, Vol. X, Pt. II, Art. 'Wahrscheinlichkeitsrechnung,' pp. 1200-1251.

A clear elementary exposition of the Method and its theory according to 1832 ENCKE.

1842 LOBATSCHESKY. 'Probabilité des résultats moyens tirés d'observations répétées.' *Crelle's Jour. Math.*, Vol. XXIV, pp. 164-170.

Serial expressions are deduced for the probability of error in the mean of a limited number of observations.

1842 MERZ. *De theoria probabilitatis adhibita in physicam*. Monachii.

1842 PUISSANT. '*Traité de géodésie, ou exposition des méthodes trigonométriques et astronomiques, applicables à la mesure de la terre, et à la construction du canevas des cartes topographiques*.' Paris, 2 vols, 4to, Vol. I, pp. xvi, 515, and XI pl. Vol. II, pp. xi, 496, xxxii, and III pl. —First edition, see 1805.

The results of many of PUISSANT's previous memoirs are here recorded, and the Method of Least Squares is often used. The work is one of the most valuable treatises on Geodesy extant.

1842 RAMUS. 'Sur une question de probabilité relative aux corrections des hauteurs barométriques.' *Crelle's Jour. Math.*, Vol. XXIV, pp. 80-84.

A determination of the probability "que dans un grand nombre d'observations la différence des résultats moyens des hauteurs barométriques observées et réduites soit comprise dans l'intervalle  $\lambda$ ."

1842 RÖBER. Experiment. Art. in *Handwörterbuch Chemie u. Phys.* (Berlin, 8vo.)

See *Archiv. Math. u. Phys.*, Vol. XI, p. 375.

1843 ARGELANDER. 'Ueber die Anwendung der Methode der kleinsten Quadrate auf einen besondern Fall.' *Astron. Nachr.*, Vol. XXI, col. 163-168.

Simplifies the formation of normal equations, etc., when the observations are made on the simple sums or differences of the unknown quantities.

1843 BERKHAN. *Ueber die Methode der kleinsten Quadrate*. Blankenburg, 8vo.

1843 COURNOT. '*Exposition de la théorie des chances et des probabilités.*' Paris, 8vo, pp. viii, 448. —German trans., Braunschweig, 1849, 8vo.

Chapters on the theory of means and the adjustment of observations are given. At the end is a table of values of the error function. COURNOT'S methods are often quite awkward.

1843 GERLING. '*Die Ausgleichungs-Rechnung der practischen Geometrie, oder die Methode der kleinsten Quadrate mit ihren Anwendungen auf geodätische Aufgaben.*' Hamburg and Gotha, 8vo, pp. xix, 409, and 4 pl.

This book is dedicated to GAUSS. The principle of Least Squares is assumed as the basis of the methods of adjustment. It consists of four parts; the first treats of direct, the second of indirect, and the third of conditioned observations, while the fourth discusses the form and number of conditional equations which need to be considered in the adjustment of triangulations.

The book is fully illustrated with practical examples, and contains the best systematized development of the application of the method to the treatment of simple geodetic measurements that has yet appeared. GERLING issued later (1845, 1855, 1862) some papers supplementary to the work, one of which contains a long list of errata.

1843 REUSCHLE. 'Ueber die Deduction der Methode der kleinsten Quadrate aus Begriffen der Wahrscheinlichkeitsrechnung.' *Crelle's Jour. Math.*, Vol. XXVI, pp. 333-364; Vol. XXVII, pp. 182-184.

This is a critical examination of the deduction of the expression for the probability of an error between given limits and of other points in the "Metaphysik" of the Method. ENCKE'S proof of the validity of the arithmetical mean (1832) is also examined and found to be imperfect.

1844. ENCKE. 'Bemerkungen zu der Abhandlung No. 22. Band 26. Heft 4, dieses Journals.' *Crelle's Jour. Math.*, Vol. XXVIII, pp. 213-222.



A reply to REUSCHLE's criticisms. ENCKE tries to explain that in the two expressions

$$\sum_0^a \varphi(x) = 1 \quad \text{and} \quad \int_0^a \varphi(x) dx = 1$$

the symbol 1 has different meanings. He also shows that REUSCHLE had failed to understand his proof of the arithmetical mean.

1844 DONKIN. An Essay on the Theory of the Combination of Observations. *Trans. Ashmolean Soc.* (Oxford. 8vo). —French abridgment, 'Sur la théorie....' in *Liouville's Jour. Math.* 1855, Vol. XV, pp. 297–322.

DONKIN attempts to establish "une espèce de Statique métaphysique sur des preuves de la même force que celles qu'on emploie en déduisant, à priori, les lois de la Statique ordinaire." The word "force" is taken to mean "tout motif qui nous porte à altérer la valeur attribuée à une quantité," and to these "forces" the principles of centre of gravity of bodies, of virtual velocities, etc., are applied, and the usual rules for the adjustment of observations by means of normal equations, weights, mean errors, etc., are deduced. No law of facility of error enters into the discussion.

DONKIN's reasoning does not always seem to me clear or rigorous.

1844 ELLIS. 'On the Method of Least Squares.' *Trans. Camb. Phil. Soc.*, Vol. VIII, pp. 204–219. —Also *Ellis's Mathematical and other Writings* (Cambridge, 1863, 8vo), pp. 12–37.

In this paper it is attempted "to bring the different modes in which the subject has been presented into juxtaposition, as that the relations which they bear to one another may be clearly apprehended."

ELLIS first takes up GAUSS's proof of 1809. He considers that GAUSS is not justified in assuming that the rule of the arithmetical mean gives the most probable values, and he shows that besides mere convenience no satisfactory reason can be assigned why it should be so regarded. His remarks on this point are extremely valuable and sound. See 1872 GLAISHER.

LAPLACE's demonstration is taken up and presented in a different but greatly simplified form, extended to the case of any number of unknown elements. GAUSS's second proof of 1823 is also analyzed and the conclusion arrived at that "nothing can be simpler or more satisfactory." Lastly IVORY's three proofs (1825–6) are discussed and their illogical character clearly exposed. The paper is one of the most valuable in the theoretical literature of the subject.

1844 JACOBI. 'Ueber eine neue Auflösungsart der bei der Methode der kleinsten Quadrate vorkommenden lineären Gleichungen.' *Astron. Nachr.*, Vol. XXII, col. 297–306.

An abridged method for the solution of certain forms of normal equations.

[1844] QUETELET. Sur l'appréciations des documents statistiques et en particulier sur l'appréciations des moyennes. *Bull. statistique de Belgique*, Vol. II.

1845 BESSEL. 'Auszug aus einem Schreiben . . . ' *Astron. Nachr.*, Vol. XXIII, col. 1-4.

On the probable errors of interpolations in logarithmic tables.

1845 FISCHER. Die Theorie der Beobachtungsfehler und ihre Ausgleichung durch die Methode der kleinsten Quadrate. Pt. I of his *Lehrbuch der höheren Geodäsie*; Darmstadt, 8vo.

1845 GERLING. 'Nachträge zur Ausgleichungs-Rechnung.' *Archiv. Math. u. Phys.*, Vol. VI, pp. 141-146, 375-378.

Three supplements to GERLING's book (1843). The first and second treat of the determination of points by angle measurements and the third of the precision of chain measurements.

1846 BRAVAIS. 'Analyse mathématique sur les probabilités des erreurs de situation d'un point.' *Mém. . . par divers savans . . Inst. France*, Vol. IX, pp. 255-332.

Observations being made on the coördinates of a point the probability that the apparent and true places are separated by a given distance is investigated, as also is the "valeur de la crainte mathématique de l'erreur" which is shown to be represented by the surface of a certain ellipsoid. The method requires the observations to be numerous.

In determining the probability that a point in a plane is located on an elementary area  $dy \cdot dx$ , BRAVAIS takes the probabilities of the  $x$  and  $y$  deflections as independent. See 1850 HERSCHEL.

1846 GALLOWAY. 'On the application of the Method of Least Squares to the Determination of the most probable Errors in a Portion of the Ordnance Survey of England.' *Mem. Astron. Soc. Lond.*, Vol. XV, pp. 23-69.

A discussion of a triangulation including ten stations at which thirty-five angles are observed subject to nineteen conditional equations. The methods of adjustment, of determining weights, of forming the conditional equations and all the steps of the process are given at length with great clearness. See *Month. Notices Astron. Soc.*, 1843, Vol. V, pp. 262-264 for a full account of contents of the memoir.

1846 QUETELET. '*Lettres à S. A. R. le Duc régnant de Saxe-Cobourg et Gotha, sur la Théorie des Probabilités appliquée aux sciences morales et politiques.*' Bruxelles, large 8vo, pp. 1-450. —English trans. by DOWNES; London, 1849, 8vo.

These letters are of so elementary a character that S. A. R. is informed of the meaning of the signs + and —. They contain however a valuable popular exposition of the Theory of means and of the laws of error. For review of the book see 1850 HERSCHHEL.

At the end of the book is an appendix containing many valuable "Notes." In pages 375–380 a table of the terms of the binomial  $(\frac{1}{2} + \frac{1}{2})^m$  for eighty terms on each side of the middle term is given and the method of its computation explained: these have since been called QUETELET's numbers, see 1869 GALTON. In pages 384–387 it is shown that the general term of the binomial  $(\frac{1}{2} + \frac{1}{2})^m$  approaches the exponential form  $ce^{-h^2x^2}$  as  $m$  indefinitely increases: this is similar to HAGEN's investigation of 1837.

In pages 412–424 are printed three suggestive letters from BRAVAIS, in which not only doubts are expressed as to the *a priori* necessity of the exponential law of facility of error, but examples are given to show that it is not universally true *a posteriori*. BRAVAIS' view is that every cause of partial error gives rise to a distinct curve of facility and that the combination of these approaches the exponential form as a limit, partly because of the necessary law that positive and negative errors are equally likely, and partly because the combination itself must tend toward the binomial form. He alludes to HAGEN's proof as not sufficiently rigorous.

1847 DEMORGAN. 'Theory of Probabilities.' *Encycl. of Pure Math. (Encycl. Metrop.)*, Pt. II, pp. 393–490.

A great part of this work is translated and adapted from LAPLACE's *Théorie . . . des Prob.*, 1812, enriched by comments. The Method of Least Squares is treated at considerable length according to LAPLACE's method. At the end are given valuable tables, those of 1799 KRAMP and 1832 ENCKE, and also factorial tables.

1847 GALLOWAY. 'Probabilities.' *Encycl. Britannica*, seventh ed., Vol. XVIII, pp. 591–639. Eighth edition, Vol. XVIII, pp. 588–636. —Also separately, Edinburgh, 1848, 8vo.

POISSON's analysis (1824) of LAPLACE's method is given, and also GAUSS's proof of 1823.

1848 MATZKA. 'Beweis des obersten Grundsatzes der Methode der kleinsten Quadrate.' *Archiv. Math. u. Phys.*, Vol. XI, pp. 369–377.

A suggestive article. Let  $x$  be the true value of a quantity for which observations give the values  $a, b, c, \dots$ , then

$$x = f(a, b, c, \dots)$$

and also we must have,

$$x - m = f(a - m, b - m, c - m, \dots).$$

Applying TAYLOR's theorem, MATZKA deduces for  $x$

$$x = \frac{ha + ib + kc + \dots}{h + i + k + \dots}.$$

in which,  $h, i, k, \dots$  are positive quantities whose values cannot be determined. If the observations are of equal weight and infinite in number the rule of the arithmetical mean is shown to follow.

1848 MEYER. Résolution d'un problème du calcul des probabilités. *Bull. Acad. Belgique*, Vol. XV, Pt. II, pp. 508-512.

1848 MEYER. 'Mémoire sur l'application du calcul des probabilités aux opérations du nivellement topographique.' *Mém. Acad. Belgique*, Vol. XXI, 25 pp.

An excellent practical paper.

1848 WOLF. Bestimmung mittlerer Längen und Gewichte. *Mittheil. Gesell. Bern* for 1848, pp. 238-243.

1849 BAEYER. *Die Küstenvermessung und ihre Verbindung mit der Berliner Grundlinie*. Berlin, 4to.

A valuable work for geodetic engineers.

1849 GÖTZE. 'Ueber die Bestimmung der Bedingungsgleichungen bei der Aufsuchungen der wahrscheinlichsten Elemente eines Himmelskörpers aus einem vollständigen Systeme von geocentrischen Beobachtungen.' *Astron. Nachr.*, Ergänzungs Heft, col. 159-234, 239-240.

1849 PAUCKER. Der Ausgleichungsbaun und der mittlere Fehler der Beobachtung. *Arbeit Kurland. Gesell.*, Vol. VII, pp. 91-131.

1849 WITTSTEIN. 'Die Methode der kleinsten Quadrate.' Appendix to *Wittstein's Lehrbuch der Differential-und-Integralrechnung* (Hannover, 1868-9, 8vo), Vol. II, pp. 343-442.

Contains a very clear exposition of HAGEN's demonstration (1837) of the law of facility of error and an excellent elementary presentation of the practical features of the method.

1849 WOLF. Note zur Methode der kleinsten Quadrate. *Mittheil. Gesell. Bern* for 1849, pp. 140-144.

1849 WOLF. Versuche zur Vergleichung der Erfahrungswahrscheinlichkeit mit der mathematischen Wahrscheinlichkeit. *Mittheil. Gesell. Bern* for 1849, pp. 97-100, 183-185; for 1850, pp. 85-88, 209-212; for 1851, pp. 17-36.

See also 1853 WOLF. I regret that I have been unable to see these articles.

1850 BACHE. 'Comparison of the Results obtained in Geodesy by the Application of the Theory of Least Squares.' *Proc. Amer. Assoc.* for 1849, pp. 102-105.

A statement of probable errors of measurements of angles in U. S. Coast Survey triangulations. At the end of the paper, which seems to be a brief abstract of the original, there are some remarks by PEIRCE, GOULD and HENRY, which probably were incorrectly reported.

1850 ENCKE. 'Ueber die Anwendung der Wahrscheinlichkeits-Rechnung auf Beobachtungen.' *Berlin Astron. Jahrb.* for 1853, pp. 310-351.

The object of this paper is to establish greater confidence in the practice of taking the arithmetical mean and in the validity of the exponential law of facility of error. Six of the ten problems of LAGRANGE's memoir of 1774 are translated and a few comments added. HAGEN's demonstration of 1837 is also given in full and spoken of in very favorable terms. ENCKE alludes to the use of the "Erfahrungssatz des Prinzips des arithmetischen Mittels" in his memoir of 1832 and says, "so blieb doch immer eine willkürliche Annahme übrig." At the end of the article is an attempt to explain why  $\int_{-\infty}^{+\infty} \varphi(x) dx = 1$ , when  $\varphi(x)$  is the probability of the error  $x$ .

1850 GUY. 'On the Relative Value of Averages derived from different Observations.' *Jour. Statis. Soc.*, Vol. VIII, pp. 30-45.

The observations discussed are statistical facts.

1850 HERSCHEL. 'QUETELET on Probabilities.' *Edinburgh Rev.*, Vol. XCII, pp. 1-57. —*Herschel's Essays* (London, 1857, 8vo), pp. 365-465.

This paper contains in a popular form another proof of the Method of Least Squares. Supposing a stone dropped with the intention that it shall hit a mark on a horizontal plane, the reasoning assumes that the deflections from rectangular axes through the mark are independent; and deduces the exponential form  $ce^{-h^2x^2}$  for the law of deviation or error. From this the Method of Least Squares at once follows. This proof was put into algebraic language by ELLIS (see below) and the unwarrantable character of the assumption clearly pointed out. See above 1846 BRAVAIS, and below 1857 BOOLE, 1867 THOMPSON and TAIT, 1872 SCHLÖMILCH, and particularly 1872 GLAISHER. See also 1808 ADRAIN, where this proof was first given.

1850 ELLIS. 'Remarks on an alleged Proof of the "Method of Least Squares," contained in a late number of the *Edinburgh Review*.' *Lond. Phil. Mag.*, Vol. XXXVII, pp. 321-328, 462. —Also *Ellis's Mathematical Writings* (Cambridge, 1863, 8vo), pp. 51-62.

HERSCHEL's proof is discussed and regarded as unsatisfactory. LAPLACE's method is also explained and defended. The paper is very interesting and valuable. See GLAISHER, *Mem. Astron. Soc. Lond.*, 1872, Vol. XXXIX, pp. 112-113; also below 1851 DONKIN.

1850 HOSSARD and POUDDRA. 'Seconde Théorème de minimum pour un système de droite dans l'espace.' *Nouv. Ann. Math.*, Vol. IX, pp. 241-242.

On the centre of gravity of a system of points. See also Vol. VII, p. 407 and 454.

1850 PAUCKER. Der mittlere Fehler zweiter Ordnung. *Arbeit Kärland. Gesell.*, Vol. VIII, pp. 104-112.

1850 VERDAM. 'Verhandeling over de methode der kleinste quadraten.' Groningen, Vol. I, 4to, pp. xxi, 409.

I have not seen Vol. II of this work and find no direct reference to its publication: it was probably published about 1853. Vol. I is devoted to the practical features of the method and Vol. II to the theory.

Vol. I assumes the principle of Least Squares and develops the methods of adjustments and comparison by probable errors, weights, etc. Numerous well chosen practical examples are given worked out in detail. The work abounds in historical information, and is the most complete text-book on the subject which has come to my notice.

1851 AIRY. 'On a Question of Probabilities which occurs in the use of a fixed collimator for the Verification of the Constancy of Position of an Azimuth Circle.' *Rep. Brit. Assoc.* for 1850, pp. 1-2.

Is it justifiable to use the Theory of Errors in finding the probable errors of quantities which are partly results of observation and partly deductions of formulæ?

1851 AIRY. 'On the Weights to be given to the separate Results for Terrestrial Longitudes, determined by Observations of Transits of the Moon and Fixed Stars.' *Mem. Astron. Soc. Lond.*, Vol. XIX, pp. 213-229.

Weight is defined as "the reciprocal of the square of the probable error." The paper discusses nine practical cases.

1851 DENZLER. 'Ueber den Fundamentalsatz der Methode der kleinsten Quadrate.' *Mittheil. Gesell. Zürich*, Vol. II, pp. 110-118.

Appears to be of little importance.

1851 DONKIN. 'On certain Questions relating to the Theory of Probabilities.' *Lond. Phil. Mag.*, Vol. I, pp. 353-368, 458-466; Vol. II, pp. 55-66.

Part III of this paper offers some critical remarks on the Theory of Least Squares with particular reference to ELLIS's paper of 1850. HERSCHEL's proof, it is said, "should be treated with respect." The Method of Least Squares may be used, if for no other reason, because "it is a very good method," as shown by GAUSS's proof of 1823.

1851 HOSSARD. 'Note sur la méthode des moindres carrés.' *Nouv. Annal. Math.*, Vol. X, pp. 456-460.

IVORY's first proof (1825) is here rediscovered under a slightly different form.

1851 PAUCKER. Uebereinstimmung der ausgeglichenen Ursachen mit den durch BESSEL's Verfahren gefundenen. *Arbeit Kurland. Gesell.*, Vol. IX, pp. 170-183.

1851 PAUCKER. Einfluss der Gewichte auf die Ausgleichung. *Arbeit Kurland. Gesell.*, Vol. IX, pp. 183-193.

The substance of this and the preceding article is given in the following.

1851 PAUCKER. 'Zur Theorie der kleinsten Quadrate.' *Bull. phys. math. Acad. St. Péters.*, Vol. IX, col. 113-125; Vol. X, col. 33-43, 233-238. — *Mél. math. Acad. St. Péters.*, Vol. I, pp. 188-204, 333-346, 433-439.

Contains new methods of computation, tests of accuracy, etc., which appear to be of little value.

1852 BIENAYMÉ. 'Mémoire sur la probabilité des erreurs d'après la méthode des moindres carrés.' *Liouville's Jour. Math.*, Vol. XVII, pp. 33-78. — *Mém. . . par divers savans. . . Inst. France*, Vol. XV, pp. 615-663.

After some interesting critical remarks, LAPLACE's analysis (1812) is given considerably simplified. According to BIENAYMÉ's investigation the formulæ for probable error ordinarily used are only correct for one unknown quantity. For two, three and four unknown quantities, he finds that the probable errors should be respectively 1.746, 2.281 and 2.716 times larger than those given by the usual formulæ. His expression for the probability that an error is included between given limits differs sensibly for several unknown quantities from the common probability integral, particularly for limits but little removed from  $x=0$ . See 1873 WREDE.

See *Comptes Rendus Acad. Paris*, Vol. XXXIV, pp. 90-92, or *Liouville's Jour. Math.*, Vol. XVII, pp. 31-32 for a report on this memoir. See also MEYER's *Calcul des Probabilités*, pp. 377-408.

1852 BIVER. *Théorie des moindres carrés établie par l'analyse pure*. Bruxelles, 8vo.

Probably similar to his memoir of 1853.

1852 DIENGER. 'Ueber die Ausgleichung der Beobachtungsfehler.' *Archiv. Math. u. Phys.*, Vol. XVIII, pp. 149-193; Vol. XIX, pp. 211-227.

HAGEN's demonstration (1837) is followed. The article forms an almost complete elementary treatise on the Method of Least Squares.

In the Supplement HAGEN's proof is abandoned, as resting on a questionable hypothesis and GAUSS's first proof is given in its place. DIENGER appreciates clearly the defects of GAUSS's method, for he requires the number of observations to be infinite in order that the value given by the arithmetical mean shall coincide with the *true* value of the measured quantity.

1852 DIENGER. 'Ueber die Bestimmung des Gewichts der nach der Methode der kleinsten Quadrate erhaltenen wahrscheinlichsten Werthe der Unbekannten, wenn Bedingungsgleichungen vorhanden sind.' *Archiv. Math. u. Phys.*, Vol. XIX, pp. 197-202.

Contains valuable practical formulæ for the computer.

1852 HARTNER. *Handbuch der niedern Geodäsie, nebst einem Anhang über die Elemente der Markscheidekunst.* Wien, 8vo. — Second edition, 1856, 8vo, pp. xvi, 611. — Fourth edition, 1872, 8vo.

See 1863 BÜRSCH.

1852 LIAGRE. 'Sur la valeur la plus probable d'un côté géodésique commun à deux triangulations.' *Bull. Acad. Belgique*, Vol. XIX, Pt. I, pp. 513-534.

A clear exposition and solution of the problem. An example from 1849 BAEYER is discussed.

1852 LIAGRE. 'Sur la loi de répartition des hauteurs barométriques, par rapport à la hauteur moyenne.' *Bull. Acad. Belgique*, Vol. XIX, Pt. II, pp. 502-514.

The law is shown to agree with the exponential law of facility of error.

1852 PEIRCE (B.) 'Criterion for the Rejection of doubtful observations.' *Gould's Astron. Jour.*, Vol. II, pp. 161-163.

This Criterion, founded on a principle of the Theory of Probability, proposes a method for determining by successive approximation, whether or not a suspected observation may be rejected. Tables are needed for its application: for these see below 1855 GOULD and 1864 CHAUVENET.

It is a fatal objection to this criterion that its use involves a contradiction of reasoning. The arithmetical mean, for instance, can only be used when the observations are all of equal weight, and the rejection of an observation which deviates considerably from the



mean asserts that the weights of the several values are not equal. See below 1856 AIRY and WINLOCK, 1868 STONE and particularly 1872 and 1873 GLAISHER.

The criterion has been used to some extent in the U. S. Coast Survey office, but has elsewhere, I believe, found no acceptance.

1852 QUETELET. 'Sur quelques propriétés curieuses qui présentent les résultats d'une série d'observations, faites dans la vue de déterminer une constant, lorsque les chances de rencontrer des écarts en plus et en moins sont égales et indépendantes les unes des autres.' *Bull. Acad. Belgique*, Vol. XIX, Pt. II, pp. 303-317.

An interesting investigation, illustrated by a discussion of meteorological observations.

1852 WOLF. Beitrag zur Lehre von der Wahrscheinlichkeit. *Mittheil. Gesell. Bern* for 1852, pp. 133-134.

1853 BIVER. 'Théorie analytique des moindres carrés.' *Liouville's Jour. Math.*, Vol. XVIII, pp. 169-200.

The principle of the arithmetical mean is proved according to 1832 ENCKE. The term "risque de erreur" is given to the function  $A + B\sum x^2 + C\sum x^4 + D + \sum x^6 + \dots$  and it is shown that this becomes a minimum when  $\sum x^2$  is a minimum, and this condition is regarded as furnishing "les valeurs les plus plausibles des inconnues." Formulæ for weights and mean errors are also developed.

1853 CAUCHY. 'Mémoire sur l'évaluation d'inconnues déterminées par un grand nombre d'équations approximatives du premier degré.' *Comptes Rendus Acad. Paris*, Vol. XXVI, pp. 1114-1122.

It is maintained that the method of interpolation (1835 CAUCHY) can be used for determining several unknown quantities from a redundant number of equations, with results nearly as accurate as by the Method of Least Squares.

1853 BIENAYMÉ. 'Remarque sur les différences qui distinguent l'interpolation de M. CAUCHY de la méthode des moindres carrés, et qui assurent la supériorité de cette méthode.' *Comptes Rendus Acad. Paris*, Vol. XXVII, pp. 5-13. — *Liouville's Jour. Math.*, Vol. XVIII, pp. 299-308.

It is maintained that the two methods differ "complètement," and that even a contradiction exists. CAUCHY's method, it is said, is only a modification of the ordinary process of elimination, which assures no especial degree of probability to the results and which requires in practice as many operations as the Method of Least Squares. See below CAUCHY.

Further remarks by BIENAYMÉ referring to this discussion are given in pages 68-69, 197, 206 of Vol. XXXVII of the *Comptes Rendus*.

1853 CAUCHY. 'Mémoire sur l'interpolation, ou Remarques sur les Remarques de M. JULES BIENAYMÉ.' *Comptes Rendus Acad. Paris*, Vol. XXXVII, pp. 64-68.

Gives an extract from the memoir of 1835, and maintains that in many investigations the method of interpolation is preferable to that of Least Squares.

1853 CAUCHY. 'Sur la nouvelle méthode d'interpolation comparée à la méthode des moindres carrés.' *Comptes Rendus Acad. Paris*, Vol. XXXVII, pp. 100-109.

The new method is claimed to be often the shortest, and the Method of Least Squares is said to give most probable results only under certain conditions.

1853 CAUCHY. 'Mémoire sur les coefficients limitateurs ou restricteurs.' *Comptes Rendus Acad. Paris*, Vol. XXXVII, pp. 150-162.

In the latter part of the article the "restricteurs" are applied to the theory of Least Squares, and it is concluded that that Method furnishes most probable results only when the law of facility of error is the same for all the errors, when no limits can be assigned to the magnitude of an error, and when the probability of an error  $x$  is proportional to  $e^{-h^2x^2}$ .

1853 CAUCHY. 'Sur les résultats moyens d'observations de même nature, et sur les résultats les plus probables.' *Comptes Rendus Acad. Paris*, Vol. XXXVII, pp. 198-206.

The conclusions of the preceding article are confirmed.

1853 CAUCHY. 'Sur la probabilité des erreurs qui affectent des résultats moyens d'observations de même nature.' *Comptes Rendus Acad. Paris*, Vol. XXXVII, pp. 264-272.

Shows that the most probable values may sometimes differ from those found by the Method of Least Squares.

1853 BIENAYMÉ. 'Considerations à l'appui de la découverte de LAPLACE sur la loi des probabilités dans la méthode des moindres carrés.' *Comptes Rendus Acad. Paris*, Vol. XXXVII, pp. 309-324. — *Liouville's Jour. Math.*, 1867, Vol. XII, pp. 158-176.

An answer and review of some of CAUCHY's articles; also maintains that the mean of the sum of the squares of the errors is under all circumstances a measure of the precision of the observations.

1853 CAUCHY. 'Sur la plus grande erreur à craindre dans un résultat moyen, et sur le système de facteurs qui rend cette plus grande erreur un minimum.' *Comptes Rendus Acad. Paris*, Vol. XXXVII, pp. 326-334.

The system of factors is often very different from that given by the Method of Least Squares.

1853 CAUCHY. 'Mémoire sur les résultats moyens d'un très grand nombre d'observations.' *Comptes Rendus Acad. Paris*, Vol. XXXVII, pp. 381-385.

An abstract only is given. The result seems to be that the mean is worthy of great confidence.

1853 GRUNERT. 'Elementare Betrachtungen über die Bildung der Bedingungsgleichungen aus gegebenen Beobachtungen.' *Archiv Math. u. Phys.*, Vol. XXI, pp. 453-486.

"Bedingungsgleichung" is not here used in its usual sense. The paper contains an investigation of the value to be taken for  $x$  when  $A - Bx = 0$ , and many values of  $A$  and  $B$  are given by observation. A certain form for  $x$  is shown to involve the principle of Least Squares.

1853 LIAGRE. *Calcul des probabilités et la théorie des erreurs, avec des applications aux sciences d'observation en general, et à la géodésie en particulier.* Bruxelles, 8vo.

This is a standard work on the subject.

1853 LIAGRE. 'Sur l'erreur probable d'un passage observé à la lunette méridienne de l'Observatoire royal de Bruxelles.' *Bull. Acad. Belgique*, Vol. XX, Pt. II, pp. 303-312.

1853 QUETELET. *Théorie des probabilités.* Bruxelles, 12mo, pp. 104.

1853 WOLF. Versuche zur Vergleichung der mathematischen Wahrscheinlichkeit. *Mittheil. Gesell. Bern* for 1853, pp. 23-28.

See also 1849 WOLF.

1853 ———. *Tafeln zur Berechnung der Wahrscheinlichkeit des Vorkommens von Beobachtungsfehler.* Berlin, lith. MS., 4to, pp. 11.

1854 D'ARREST. 'Beitrag zur Methode der kleinsten Quadrate.' *Bericht. Sächsich. Gesell.*, 1854, pp. 133-136. — *Astron. Nachr.*, Vol. XLI, col. 35-40.

Points out six new geometrical properties of the probability curve, and shows how its equation may be derived from a certain mechanical idea.

1854 HÉLIE. *Mémoire sur la probabilité du tir des projectiles de l'artillerie navale.* Paris, 4to. —Second ed., 1856, 8vo.

1855 BACHE. 'Comparison of the reduction of horizontal angles by the methods of dependant directions and of dependant angular quantities, by the method of least squares.' *Rep. Coast Survey U. S.* for 1854, pp. 63\*-70\*.

The first method is shown to possess a slight advantage.

1855 BERTRAND. '*Méthode des moindres carrés. Mémoires sur la combinaison des observations, par CH. FR. GAUSS.* Paris, 8vo, pp. 167.

This volume renders quite accessible the Latin memoirs of GAUSS. It contains translations of pages 208-220 of the *Theoria motus* . . . . 1809, pages 20-26 of *Disquisito de . . . . Palladis*, 1811, and the whole of the memoirs of 1816, 1822, 1823, 1826 and 1827. The memoirs of 1823 and 1827 form the bulk of the book, the others being added at the end as "Notes."

1855 BERTRAND. 'Sur la méthode des moindres carrés.' *Comptes Rendus Acad. Paris*, Vol. XI, pp. 1190-1192.

Historical and critical remarks made on presenting a copy of the above book to the Paris Academy.

1855 GERLING. 'Ueber die Schätzung des mittlern Fehlers directer Beobachtungen.' *Archiv Math. u. Phys.*, Vol. XXV, pp. 219-222.

Contains three pages of corrections and errata to his book (1843).

1855 GOULD. 'Report . . . . containing directions and tables for the use of PEARCE'S Criterion for the Rejection of Doubtful Observations.' *Rep. Coast Survey U. S.* for 1854, pp. 131\*-138\*.

Reprinted with a different title in *Gould's Astron. Jour.*, 1855, Vol. IV, pp. 81-87.

1855 HILGARD. 'Discussion of the probable error of observation with a twenty-six inch portable transit . . . . .' *Rep. Coast Sur. U. S.*, for 1854, p. 121\*.

The probable error is given as  $\pm 0.072^s$ .

1855 LIAGRE. 'Sur la probabilité de l'existence d'une cause d'erreur régulière dans une série d'observations.' *Bull. Acad. Belgique*, Vol. XXII, Pt. II, pp. 9-13, 15-54.

A valuable theoretical discussion illustrated with practical examples.

1855 LLOYD. On the mean results of observations. *Trans. Irish Acad.*, Vol. XXII, pp. 61-73.

See abstract in *Proc. Irish Acad.*, Vol. IV, pp. 180-183.

1855 PEIRCE (B.). 'Report upon the Determination of Longitude by Moon Culminations.' *Rep. Coast Sur. U. S.* for 1854, pp. 109\*-120\*.

"The small errors which are beyond the limits of human perception, are not distributed according to the mode recognized by the Method of Least Squares, but either with the uniformity which is the ordinary characteristic of matters of chance, or more frequently in some arbitrary form dependant upon individual peculiarities . . . ."

1855 SCHOTT. 'Adjustment of horizontal angles of a triangulation.' *Rep. Coast Sur. U. S.*, for 1854, pp. 70\*-86\*.

This and many of SCHOTT's following papers are very valuable, but they are not usually clear except to those who already understand the subject.

1855 SCHOTT. 'Probable error of observation derived from observations of horizontal angles at any single station, and depending on directions.' *Rep. Coast Sur. U. S.* for 1854, pp. 86\*-95\*.

A discussion of 350 measurements taken at eleven stations.

1856 AIRY. 'Letter from . . . [Remarks on PEIRCE's Criterion.]' *Gould's Astron. Jour.*, Vol. IV, pp. 137-138.

The Criterion is strongly opposed. ". . . the whole theory is defective in its foundations and illusory in its results." It must be said, however, that some of AIRY's objections are not supported by very good logic.

1856 WINLOCK. 'On Professor AIRY's objections to PEIRCE's Criterion.' *Gould's Astron. Jour.*, Vol. IV, pp. 145-147.

AIRY's objections are taken up in detail; some of them are shown to apply equally well to the Method of Least Squares.

1856 PETERS. 'Ueber die Bestimmung des wahrscheinlichen Fehlers einer Beobachtung aus den Abweichungen der Beobachtungen von ihrem arithmetischen Mittel.' *Astron. Nachr.*, Vol. XLIV, col. 29-32. —Trans. in *Rep. Coast Sur. U. S.* for 1856, pp. 307-308.

Let  $\Sigma x$  be the sum of the residual errors all taken positive, and  $n$  the number of direct observations of equal weight. Then PETERS' result is, that  $r$ , the probable error of a single observation is,

$$r = 0.845347 \frac{\Sigma x}{\sqrt{n(n-1)}}$$

See on this formula 1869 LÜBROTH, and 1875 HELMERT

1856 SCHOTT. 'Solution of Normal Equations by indirect Elimination.' *Rep. Coast Sur. U. S.* for 1855, pp. 255-264.

Several methods are given and illustrated by numerical examples. The paper is of great value to a computer.

1856 SCHOTT. 'Report . . . . of a discussion of the secular variation in the magnetic declination on the Atlantic and part of the Gulf Coast of the United States.' *Rep. Coast Survey U. S.* for 1855, pp. 306-337.

The process of deducing empirical formulæ for declination from observations by the Method of Least Squares is explained and illustrated, as also that of finding the probable errors of the constants which enter into such formulæ and of the computed results. Formulæ are deduced for fourteen stations. See also *Rep. Coast Survey* for 1855, p. 306, and for 1859, p. 296.

1856 VORLÄNDER. 'Ueber die Genauigkeit der Längenmessungen mit der Messkette auf verschiedenen Bodenarten.' *Zeitschr. Math. u. Phys.*, Vol. I, pp. 142-159.

The precision is regarded as inversely proportional to the length of the line. Tables are given showing results for different kinds of ground. See 1863 BÖRSCH.

1857 ANDRÄ. 'Fehlerbestimmung bei der Auflösung der POTHE-NOT'schen Aufgabe mit dem Messtische.' *Astron. Nachr.*, Vol. XLVII, col. 193-202.

Points for which the probabilities of error are equal have an ellipse as locus. The most probable ellipse is assumed to be given by the Method of Least Squares. See *Bull. math. phys. Acad. St. Péters.*, Vol. VII, p. 145.

1857 D'ARREST. 'Schreiben . . . [über die Berechnung der Gewichte].' *Astron. Nachr.*, Vol. XLVII, col. 17-20.

Contains formulæ for the easy determination of the relative weights of three unknown quantities, and also remarks concerning the geometric signification of weights and their connection with determinants.

1857 BABINET and HOUSEL. '*Calculs pratiques appliqués aux sciences d'observation.*' Paris, 8vo, pp. xvi, 388.

Mostly devoted to the theory of numerical approximations and interpolation formulæ. Two pages are given to the Method of Least Squares.

1857 BAUR. —————. *Programm des Stuttgarter Polytechnikursus für 1857.*

An article on determination of weights, etc.

1857 BELLAVITIS. Considerazioni sulla theoria della probabilita. *Atti Istit. Venezia* for 1856-7, pp. 299-321.

1857 BOND. 'On the use of Equivalent Factors in the Method of Least Squares.' *Mem. Amer. Acad.*, Vol. VI, pp. 179-212. —Also privately printed, Cambridge, 1858, 4to, pp. 36.

It is shown that it is unnecessary to adhere in numerical computations to the strict letter of the Method of Least Squares, and that its application " . . . . . requires the use of such numbers only, in the arithmetical processes peculiar to it and characteristic of the Method, as may be designated by one of the numerals 0, 1, 2, . . . 9, or of the fractions  $\frac{1}{2}, \frac{1}{3}, \dots, \frac{1}{9}$ , or by a product of one of these numbers by an integral power of 10."

1857 BOOLE. On the Application of the Theory of Probabilities to the question of the Combination of Testimonies or Judgments. *Trans. Soc. Edinb.*, Vol. XXI, pp. 597-652.

In the first part of this memoir the rule of the arithmetical mean is discussed. "The result of BOOLE's investigation is that if  $n$  observations  $p_1, p_2, \dots, p_n$  be made upon the same quantity, then the most probable value of that quantity is a certain linear function of  $p_1, p_2, \dots, p_n$ ; this BOOLE demonstrates by his Calculus of Logic, and the analysis is of so peculiar a character that . . . I feel scarcely qualified to express a decided opinion on its merits. . . . the [final] result takes the form of the arithmetic mean."—GLAISHER, *Mem. Astron. Soc. Lond.*, 1872, Vol. XXXIX, p. 124.

In the latter part of the paper HERSCHEL's demonstration is reproduced and defended against the arguments of ELLIS; see 1850. See GLAISHER's paper, just quoted, pp. 115.

1857 DIENGER. 'Ausgleichung der Beobachtungsfehler nach der Methode der kleinsten Quadratssummen. Mit zahlreichen Anwendung, namentlich auf geodätische Messungen.' Braunschweig, 8vo, pp. viii, 168.

An excellent elementary text-book. GAUSS's proof of 1809 is followed, with the improvement that the probability of a definite error is an infinitesimal. See 1852 DIENGER. Among the practical questions treated is the theory of repetitions in angle measurements.

1857 DONKIN. 'On an Analogy relating to the Theory of Probabilities, and on the Principle of the Method of Least Squares.' *Quart. Jour. Math.*, Vol. I, pp. 152-162.

Donkin observes that if two observations of an unknown quantity give  $x=a$  and  $x=b$ , then the most probable value of  $x$  is  $\frac{1}{2}(a+b)$ , but that we cannot regard the arithmetical mean of more than two observations as most probable. Taking  $x$  to represent the true value of the unknown quantity DONKIN says: ". . . it appears a natural and

obvious assumption (though I do not pretend that it is *not* an assumption) that *the probability that  $x$  is between  $x$  and  $x+dx$  must be expressible in the form  $\psi\left(x-\frac{a+b}{2}\right)dx$ .* From this the exponential law of facility of error is deduced.

For an analysis of this reasoning see GLAISHER, *Mem. Astron. Soc. Lond.*, Vol. XXXIX, p. 118, who classes it among the proofs of the Method.

1857 LIAGRE. Sur la mesure de précision des observations méridiennes faites à l'Observatoire royal de Bruxelles. *Bull. Acad. Belgique*, Vol. III, pp. 330-338.

1857 PETZVAL. 'Fortsetzung des Berichtes über optische Untersuchungen. [Ausgleichungstheorie].' *Sitzungsber. math-nat. Acad. Wien*, Vol. XXIV, pp. 129-144.

PETZVAL concludes that the Method of Least Squares is entirely inapplicable in Optics. He proposes "die Methode der numerisch gleichen Maxima und Minima," which consists in making the sum of the  $2m$  powers a minimum,  $m$  being a variable which tends toward infinity as a limit. The development and application of this method is to constitute the First Part of Vol. III of his work on Optics. This method was mentioned by LAPLACE in the *Théorie... des Probabilités*, p. 345.

1857 SAWITSCH. *Die Anwendung der Wahrscheinlichkeitstheorie auf die Berechnung der Beobachtungen und geodätische Messungen, oder die Methode der kleinsten Quadrate.* (Russian). St. Petersburg, 8vo. —German edition, Leipzig, 1863, 8vo.

1857 VORLÄNDER. 'Ueber das geodätische Vorwärts-Einschneiden.' *Zeitschr. Math. u. Phys.*, Vol. II, pp. 299-316.

A practical application of the Method of Least Squares.

1857 WREDE. 'Några anmärkningar rörande minsta quadrat-metodens tillämpning.' *Öfvers. Acad. Förhandl. Stockholm*, Vol. XIV, pp. 73-81.

On the error ellipse.

1857 ZECH. *Einladung zur akademischen Feier des Geburtstags des Königs von Württemberg, nebst einer Abhandlung zur Methode der kleinsten Quadrate.* Tübingen, 4to.

The first exhaustive discussion of the adjustment of indirect observations subject to conditional equations. See JORDAN, *Elemente der Vermessungskunde* (Stuttgart, 1877, 8vo), p. 6.



1858 BOUNIAKOWSKY. 'Sur un instrument destiné à faciliter l'application numérique de la méthode des moindres carrés, et à contrôler les résultats obtenus par cette méthode.' *Bull. phys. math. Acad. St. Péters.*, Vol. XVII, col. 289-298. — *Mél. math. Acad. St. Péters.*, Vol. II, pp. 602-614.

A machine for calculating the sums  $a_1^2 + a_2^2 + a_3^2 + \dots$ , and  $a_1b_1 + a_2b_2 + a_3b_3 + \dots$ .

1858 CASORATI. 'Intorno ad alcuni punti della theoria dei minimi quadrati.' *Annali di Math.*, Vol. I, pp. 329-343.

Discussion by the use of determinants, etc.

1858 CLARKE. 'Ordnance Trigonometrical Survey of Great Britain and Ireland. Account of the Observations and Calculations of the Principal Triangulations and of the Figure, Dimensions and mean Specific Gravity of the Earth as derived therefrom.' London, 4to, pp. xvii, 782, with an Atlas of 28 Plates.

The whole triangulation is adjusted by the Method of Least Squares. The method of correlatives is explained at length and illustrated for a case involving seventy-four observations subject to thirty-nine conditional equations. An inspection of this book will give students an idea of the stupendous calculations which men of science undertake and execute.

1858 DIDION. *Calcul des probabilités appliqué au tir des projectiles.* Paris, 8vo.

For an exposition of this subject see SONNET's *Dictionnaire des mathématiques appliquées*, (Paris, 1867), pp. 1103-1108.

1858 GRUNERT. 'Drei Grössen  $x, y, z$ , deren Summe die gegebene Grösse  $s$  ist, sind durch Messung bestimmt worden, und man habe dadurch für diese drei Grössen respective die Werthe  $a, b, c$  erhalten. Da diese Werthe mit Beobachtungsfehler behaftet sind, und ihre Summe also im Allgemeinen nicht genau  $s$  ist, so soll man dieselben so verbessern, dass die verbesserten Werthe genau die Summe  $s$  geben, und die Summe der Quadrate der Verbesserungen ein Minimum ist.' *Archiv. Math. u. Phys.*, Vol. XXXI, pp. 480-481.

1858 JULLIEN. 'Mémoire sur la probabilité des erreurs dans la somme ou dans la moyenne de plusieurs observations.' *Annali di Math.*, Vol. I, pp. 76-88, 149-155, 227-237.

Errors subject to the law of facility  $\varphi(x) = \text{constant}$  are particularly discussed.

1858 KOHLER. '*Die Landesvermessung des Königsreichs Württemberg.*' Stuttgart, 8vo, pp. xii, 428, and 3 pl.

In the Appendix particularly are applications of the Method of Least Squares.

1858 RITTER. '*Manual théorique de l'application de la méthode des moindres carrés au calcul des observations.*' Paris, 8vo, pp. 80.

An excellent little text-book, in which GAUSS's first demonstration is followed, with the improvement that the probability of a single error is an infinitesimal.

1858 SCHINDLER. *Ueber Fehler bei der Berechnung eines ebenen Dreiecks.* Prag, 4to.

1858 SCHOTT. 'Account of the method and formulæ for the determination of the astronomical latitude by means of the zenith telescope as used in the survey of the coast of the United States.' *Rep. Coast Survey U. S.* for 1857, pp. 324-334.

Weights and probable errors are found. The notation used on p. 333 is unusual and uncouth.

1858 TCHÉBYCHEFF. 'Sur les fractions continues.' *Liouville's Jour. Math.*, Vol. III, pp. 289-325.

Translated from the Russian by BIENAYMÉ: treats of interpolation by the Method of Least Squares.

1858 TCHÉBYCHEFF. 'Sur l'interpolation des valeurs fournis par les observations.' *Bull. phys. math. Acad. St. Péters.*, Vol. XVI, col. 353-357. — *Mél. math. Acad. St. Péters.*, Vol. II, pp. 345-351.

1858 VORLÄNDER. 'Zur praktischen Geometrie.' *Zeitschr. Math. u. Phys.*, Vol. III, pp. 189-193.

On the adjustment of a quadrilateral whose sides and diagonals are measured.

1858 VORLÄNDER. 'Bemerkungen über das numerische Eliminiren bei geodatischen Operationen.' *Zeitschr. Math. u. Phys.*, Vol. III, pp. 16-22.

On methods of abridging the computations.

1858 GERLING. 'Bemerkungen über das indirecte Eliminiren bei geodätischen Arbeiten.' *Zeitschr. Math. u. Phys.*, Vol. III, pp. 377-382.

Referring to the preceding article of VORLÄNDER.

1858 VORLÄNDER. *Ausgleichung der Fehler polygonometrischer Messungen.* Leipzig, 8vo, pp. 55.

Besides the Method of Least Squares shorter approximate processes are given.

1858 DIENGER. 'Ueber die Ermittlung des wahrscheinlichen Fehlers bei Längenmessungen.' *Archiv. Math. u. Phys.*, Vol. XXXI, pp. 225–228.

Opposes VORLÄNDER's method given in the preceding.

1859 TCHÉBYCHEFF. 'Sur l'interpolation dans le cas d'un grand nombre de données fournies par les observations.' *Mém. Acad. St. Péters.*, Vol. I, No. 5, 81 pp.

1859 TCHÉBYCHEFF. 'Sur l'interpolation par la méthode des moindres carrés.' *Mém. Acad. St. Péters.*, Vol. I, No. 15, 24 pp.

[1860] BAEYER. *Wissenschaftliche Begründung der Rechnungsmethoden des Centralbureaus der europäischen Gradmessung: I. Die Methode der kleinsten Quadrate. II. Die Anwendung derselben auf Geodäsie.* [Lith. MSS.?] 4to.

1860 DEDAKIND. 'Ueber die Bestimmung der Präcision einer Beobachtungsmethode nach der Methode der kleinsten Quadrate.' *Vierteljahrs. Gesell. Zürich*, Vol. V, pp. 76–83.

The most probable value of the measure of precision  $h$  is found to be  $\sqrt{\frac{n-1}{2\sum x^2}}$  and not  $\sqrt{\frac{n}{2\sum x^2}}$ . See 1866 BÜRSCH.

1860 HULTMANN. *Sur les moindres carrés.* Stockholm, 4to.

1861 AIRY. 'On the Algebraical and Numerical Theory of Errors of Observations and the Combination of Observations.' Cambridge and London, 8vo, pp. xvi, 103. --Second ed., 1875.

Only LAPLACE's *Théorie analytique des Probabilités* was consulted in preparing this book, and as a consequence it is unreadable except by those already thoroughly acquainted with the subject.

1861 BORCHARDT. 'Ueber Interpolation nach der Methode der kleinsten Quadrate.' *Crelle's Jour. Math.*, Vol. LVIII, pp. 270–272.

On TCHÉBYCHEF's method; see 1858 and 1859.

1861 GERLING. Notiz in Betreff der Prioritäts-Verhältnisse in Beziehung auf die Methode der kleinsten Quadrate. *Nachr. Gesell. Göttingen* for 1861, pp. 273-275.

1861 PETERS. *Ueber die Bestimmung des Längenunterschieds zwischen Altona und Schwerin.* Altona, 4to.

Contains among other matter a detailed history of the discovery of the personal equation. See 1866 RADAU.

1861 SCHOTT. 'Account of CAUCHY's interpolation formula.' *Rep. Coast Sur. U. S.* for 1860, pp. 392-396.

This is a free translation of CAUCHY's article of 1835. The method is illustrated by an example.

1861 WINCKLER. 'Ueber den mittlern Fehler der Kettenmessungen.' *Zeitschr. Math. u. Phys.*, Vol. VI, pp. 109-119.

An excellent practical paper. The mean error is found to be proportional to the square root of the length of the line.

1862 GERLING. 'Ueber Genauigkeit der Functionen bedingter Beobachtungen.' *Archiv. Math. u. Phys.*, Vol. XXXVIII, pp. 379-381.

Contains additions and corrections to his book (1843).

1862 SEIDEL. Ueber eine Anwendung der Wahrscheinlichkeitsrechnung bezüglich auf der Schwankungen in den Durchsichtigkeitsverhältnissen der Luft. *Sitzungsber. Baiersch. Acad.*, Vol. II, pp. 320-349.

1863 BÖRSCH. 'Ueber die Genauigkeit der Winkel- und Linien-Messungen.' *Zeitschr. Math. u. Phys.*, Vol. VIII, pp. 321-341.

It is concluded that the precision of angle measurements is proportional to the square root of the number of single observations, or to the number of repetitions; and that the precision of linear measurements is inversely proportional to the square root of the length of the line. The articles of VORLÄNDER (see 1856) are discussed as also is HARTNER's (1852) treatment of this subject.

1863 FREEDEN. '*Die Praxis der Methode der kleinsten Quadrate für die Bedürfnisse der Anfänger bearbeitet.*—Erster Theil: Elementare Darstellung der Methode nebst Sammlung vollständig berechneter physikalischer, meteorologischer, geodätischer und astronomischer Aufgaben, welche auf lineäre und transcendente Gleichungen führen.' Braunschweig, 8vo, pp. viii, 114.

An excellent little book, although some of the examples are rather long for a beginner. The principle of Least Squares is assumed.

1863 KURZ. 'Ueber der Methode der kleinsten Quadrate.' *Vierteljahrsschr. Gesell. Zürich*, Vol. VIII, pp. 225-240.

On the various methods of forming and solving normal equations, of determining weights, etc.

1863 LOBATTO. Over de waarschijnlijkheid van gemiddelde uitkomsten uit een groot aantal waarnemingen. *Archief. Wisk. Genoots*, Vol. II, pp. 96-127.

1864 CHAUVENET. 'Method of Least Squares.' Appendix to *Manual of Spherical and Practical Astronomy* (Philadelphia, 8vo), Vol. II, pp. 469-566. —Also as separate issue under title '*A Treatise on the Method of Least Squares*, . . . ' Philadelphia, 1868.

This is mainly an abridgment of ENCKE's memoirs of 1832. ENCKE's demonstration of the rule of the arithmetical mean is in particular set forth with confidence. The reasoning showing that if  $\varphi(x)$  is the probability of the error  $x$ ,  $\varphi(x)dx$  is the rigorous probability that an error falls between  $x$  and  $x+dx$  is very illogical. At the end are valuable tables, two of the probability integral, and others for using PEIRCE's criterion which is given nearly in the words of its author; see 1852 and 1856. CHAUVENET adds an approximate criterion for the rejection of one doubtful observation, which is derived "directly from the fundamental formula upon which the whole theory of the Method of Least Squares is based."

1864 CHRISTOFFEL. *Bestimmung einer Oberfläche durch lokale Messungen*. [Berlin], 4to.

1864 DEMORGAN. 'On the Theory of the Errors of Observation.' *Trans. Camb. Phil. Soc.*, Vol. X, pp. 409-427.

This is a very valuable contribution to the theory of the arithmetical mean. It is shown that the average "is not merely the *mean value of all the given values*: it is also the *mean supposition of all possible suppositions* as to the mode of obtaining that value," but that "the average is the most probable result only so long as we know nothing of the law of facility of error." See GLAISHER, *Mem. Astron. Soc. Lond.*, 1872, Vol. XXXIX, p. 90.

DEMORGAN suggests the name "*critical error*" instead of *probable error*. The entire paper, like all of DEMORGAN's writings, is very interesting and suggestive.

1864 SCHOTT. 'Development of BESSEL's function for the effect of periodic forces, for durations of periods frequently occurring in meteorological and magnetical investigations; with examples.' *Rep. Coast Survey U. S.* for 1862, pp. 232-235.

See above 1828 BESSEL.

1864 WOOLHOUSE. 'On Interpolation, Summation, and the Adjustment of Numerical Tables.' *Lond. Assurance Mag.*, Vol. XI, pp. 61-88, 300-332; Vol. XII, pp. 136-175.

1865 BRÜNNOW. 'The Method of Least Squares.' *Spherical Astronomy* (First English from the second German edition, London and New York, 8vo), pp. 40-60.

A very elementary sketch of the Method.

1865 GOOSS. '*Begründung der Methode der kleinsten Quadrate.*' Kreutznach, 8vo, pp. 32.

A doctor's thesis. Contains a deduction of the law  $y = ce^{-h^2x^2}$  from the axioms that the curve is symmetrical, that it has the axis of  $x$  for an asymptote, that the equation must be a simple one, etc. The discussion is not very satisfactory.

1865 TAIT. 'On the Law of Frequency of Error.' *Trans. Soc. Edinb.*, Vol. XXIV, 7 pp.

The principle of the investigation is that an error arising from any source may be compared to the deviation from the most probable result of the number of white or black balls obtained by a great number of drawings from a bag containing equal numbers of white and black balls. The idea and the algebraic work is nearly the same as QUETELET's investigation of 1846. See 1872 GLAISHER.

1865 TODHUNTER. '*A History of the Mathematical Theory of Probability from the time of PASCAL to that of LAPLACE.*' Cambridge and London, 8vo, pp. xvi, 624.

This work is invaluable to all students of the Theory of Probability and I have to acknowledge my great indebtedness to it in preparing the early part of this list. None but those who have undertaken such historical researches can form an idea of the immense amount of labor which must have been done in preparing a work like this of TODHUNTER.

TODHUNTER's analyses of the memoirs of LAGRANGE and LAPLACE are full and clear, and his commentary on LAPLACE's proof of the Method of Least Squares greatly simplifies the tedious investigations of the *Théorie analytique des Probabilités*. An account of GAUSS's proof of 1809 is not given.

1866 BÖRSCH. 'Ueber die mittlern Fehler der Resultate aus trigonometrischen Messungen.' *Archiv. Math. u. Phys.*, Vol. XLVI, pp. 40-44.

$\sum x^2$  being the sum of the squares of the residual errors and  $n$  the number of direct observations, the mean error has been taken as

$\sqrt{\frac{\sum x^2}{n}}$  and  $\sqrt{\frac{\sum x^2}{n-1}}$ . The paper compares the results given by these two formulæ and accords the preference to the first. See 1816 BESSEL, 1816 GAUSS, 1823 GAUSS and 1860 DEDAKIND.

1866 NATANI. 'Quadrate (Methode der kleinsten).' *Hoffmann's Mathematisches Wörterbuch*, Vol. V, pp. 16-33.

GAUSS's proof of 1808 and HAGEN's of 1837 are given, and free use is made of WITTSTEIN's work of 1849. The familiar equation expressing the law of facility of error appears here under the strange notation  $\varphi(\gamma) = Ce^{-a^2\gamma^2}$ .

1866 RADAU. 'Ueber die persönlichen Gleichungen bei Beobachtungen derselben Erscheinungen durch verschiedene Beobachter.' *Reper. f. phys. Technik*, Vol. I, pp. 202-218, 306-321; Vol. II, pp. 115-156.

This is a translation from the *Moniteur scientifique* for 1865. It gives a detailed history and discussion of the subject of personal equation. See 1861 PETERS.

1866 SCHOTT. 'The problem of determining a position by angles observed upon a number of given stations. Solution of GAUSS, with example.' *Rep. Coast Survey U. S. for 1864*, pp. 116-119.

The method is taken from GERLING's book, see 1840.

1866 SCHOTT. 'Report on the method of reduction, and results of the connection of the Epping base line with the primary triangulation in the Eastern States.' *Rep. Coast Survey U. S. for 1864*, pp. 120-144.

A valuable practical paper containing determinations of probable errors of observations, and the discussion of a case of adjustment in solving thirty-five normal equations and fifty-eight equations of correlatives.

1866 WINCKLER. 'Allgemeine Sätze zur Theorie der unregelmässigen Beobachtungsfehler.' *Sitzungsber. Akad. Wein*, Vol. LIII, Pt. II, pp. 6-41.

An investigation of relations between mean values of powers of errors and expressions for probability of errors.

1867 ANDRÆ. *Den Danske Gradmaaling*. Vol. I, Kopenhagen, 4to, pp. 608. Vol. II in 1873, pp. 504.

The adjustment of indirect observations subject to conditional equations is fully treated.

1867 HAGEN. 'Grundzüge der Wahrscheinlichkeits-Rechnung.' Second edition, Berlin, large 8vo, pp. x, 187.

This is rewritten from the edition of 1837. The proof of the law of facility is given substantially the same as before. The distinction between true and computed errors is not however clearly drawn.

The book is an excellent one for students and engineers, the greater part being of a practical character.

1867 HANSEN. 'Von der Methode der kleinsten Quadrate im Allgemeinen und in ihrer Anwendung auf die Geodäsie.' *Abhandl. Sächsisch. Gesell.*, Vol. XIII, pp. 571-806. —Also separately, Leipzig, 8vo, pp. 236.

In the opening pages the law of facility  $\varphi(x) = h\pi^{-\frac{1}{2}} e^{-h^2 x^2}$  is deduced by GAUSS's method of 1809,  $x$  being regarded as the residual or computed error. The remarks on page 797 concerning probable errors seem to be true and valuable. The book is particularly full in the treatment of conditioned observations, and is a valuable one for geodetic engineers. See 1868 and 1869 for supplements to the work.

1867 SCHOTT. 'Results of the primary triangulation of the coast of New England, from the north-eastern boundary to the vicinity of New York.' *Report Coast Survey U. S.* for 1865, pp. 187-203.

A continuation of SCHOTT's articles of 1855 and 1866, devoted mainly to the discussion of the probable errors of the linear and angular measurements of the triangulation. A comparison is also given of the measured lengths of three base lines with the lengths as computed through the triangulation. The paper is a very valuable one.

1867 THOMPSON and TAIT. 'Experience.' Chap. III, of their *Treatise on Natural Philosophy*, (Oxford, 8vo), Vol. I, pp. 303-320.

HERSCHEL's proof (1850) is given and spoken of as "simple and apparently satisfactory." See below 1872 SCHLÜMILCH.

1867 TCHÉBYCHEFF. 'Des valeurs moyens.' *Rec. Sci. Math.*, Vol. II. —*Liouville's Jour. Math.*, Vol. XII, pp. 177-184.

On "Espérances mathématiques," their arithmetical means, etc.

1868 FRISIANI. 'Sulle più vantaggiosa combinazione delle osservazioni.' *Mem. Istit. Lombardo*, Vol. II, pp. 1-21.

The principle of Least Squares is proved, assuming that the arithmetical mean gives the most probable result.

1868 HANSEN. 'Fortgesetzte geodätische Untersuchungen, bestehend in zehn Supplementen zur Abhandlung von der Methode der



kleinsten Quadrate im Allgemeinen und in ihrer Anwendung auf die Geodäsie.' *Abhandl. Sächsisch. Gesell.*, Vol. XIV, pp. 1-184.

For review see *Jahrb. Fortschr. Math.*, Vol. I, p. 388.

1868 HELMERT. 'Studien über rationelle Vermessungen im Gebiete der höheren Geodäsie.' *Zeitschr. Math. u. Phys.*, Vol. XIII, pp. 73-120, 183-186.

See *Jahrb. Fortschr. Math.*, Vol. I, p. 389.

1868 HENCKE. *Ueber die Methode der kleinsten Quadrate.* Leipzig, 8vo.

A doctor's dissertation containing historical and critical information relating to Least Squares. I regret that I have been unable to see a copy of it.

1868 LeBOULENGÉ. 'Études de ballistique expérimentale.' *Mém. Acad. Belgique*, Vol. XX, pp. 1-94.

Contains applications of the Method of Least Squares.

1868 MILLER-HAUENFELS. '*Höhere Markscheidekunst. Praktisch-theoretische Anleitung beim Markscheiden die vermeidlichen Fehler zu umgehen, die unvermeidlichen aber in einfacher und streng wissenschaftlicher Weise zu verbessern.*' Wien, 8vo, pp. xii, 291.

A valuable book for mining engineers. In the first or practical part processes and their applications are given, while the proofs follow in the second part. An attempt is made to show that the arithmetical mean is the most probable result by the theory of combinations, all true errors being taken as equal. The term *absolute weight* is introduced for  $h^2$ . GAUSS's first proof of the Method of Least Squares is given.

1868 SCHIAPARELLI. 'Sul principio della media aritmetica nel calcolo dei risultati delle osservazioni.' *Instist. Lombard. Rendiconti*, Vol. I, pp. 771-778.

Contains a new demonstration of the validity of the arithmetical mean. See 1875.

1868 STONE. 'On the Rejection of Discordant Observations.' *Month. Not. Astron. Soc. Lond.*, Vol. XXVIII, pp. 165-168.

PEIRCE's and CHAUVENET's criteria (see 1852 and 1864) are regarded as troublesome to use and as based on an erroneous principle, and a criterion is proposed, which embodies, in the opinion of the author, the true grounds on which the judgment rests when rejecting discordant observations or mistakes. See below 1873 GLAISHER and STONE.

1869 DORNA. 'Sulla media arithmetica vel calcolo di compensazione.' *Atti. Accad. Torino*, Vol. IV, pp. 757-763.

On ENCKE's demonstration of the arithmetical mean, and on SCHIAPARELLI's article of 1868.

1869 FAA DE BRUNO. '*Traité élémentaire du calcul des erreurs, avec des tables stéréotypées, ouvrage utile à ceux qui cultivent les sciences d'observation.*' Paris, 8vo, pp. vii, 72, XLV.

The tables are the best part of this *ouvrage*, but in that giving the values of  $\sin^2$  there is at least one dangerous error. This was one of the first books on the Method of Least Squares which I read, and I take this opportunity to warn young students against it. The text is full of typographical and other errors and the subject is presented neither clearly or fully. The list of literature at the end does not contain the names of LEGENDRE, IVORY, ENCKE, BESSEL, ELLIS, or HERSCHL, gives only one work by HANSEN, and does not mention GAUSS's *Theoria motus*..... The book deserves a speedy oblivion.

1869 GALTON. '*Hereditary Genius; an Inquiry into its Laws and Consequences.*' London, 8vo. —Amer. edition, 1870.

The exponential law of error is used in dividing mankind into grades of intellect. QUETELET's numbers (1846) are employed for this purpose and are given in the appendix.

1869 HANSEN. 'Entwicklung eines neuen veränderten Verfahrens zur Ausgleichung eines Dreiecksnetzes mit besonderer Betrachtung des Falles in welchem gewisse Winkel voraus bestimmte Werthe bekommen sollen.' *Abhandl. Sächs. Gesell.*, Vol. XIV, pp. 185-287.

1869 HELMERT. 'Beiträge zur Theorie der Ausgleichung trigonometrischer Netze.' *Zeitschr. Math. u. Phys.*, Vol. XIV, pp. 174-208.

See *Jahrb. Fortschr. Math.*, Vol. II, p. 835.

1869 JORDAN. 'Ueber die Bestimmung der Genauigkeit mehrfach wiederholter Beobachtungen einer Unbekannten.' *Astron. Nachr.*, Vol. LXXIV, col. 209-226.

Contains a method for finding probable errors from the  $\frac{1}{2}n(n-1)$  differences between  $n$  observations taken two by two. See below ANDRÄ.

1869 ANDRÄ. 'Schreiben....[om Bestemmelsen af den sandsynlige Feil ved Hjaelp af lagttagelsesernes Diffentser].' *Astron. Nachr.*, Vol. LXXIV, col. 283-284.

Objects to JORDAN's method on the ground that the differences are not independent. See 1872 for continuation of this discussion.

1869 LÜROTH. 'Bemerkung über die Bestimmung des wahrscheinlichen Fehlers.' *Astron. Nachr.*, Vol. LXXIII, col. 187-190.

If  $n$  be the number of observations and  $q$  that of the unknown quantities, the probable error of a single observation is found to be

$$r = 0.8453 \frac{\sum x}{\sqrt{n(n-q)}}.$$

This is an extension of the formula given by PETERS in 1856. See 1876 HELMERT.

1869 ROGERS. 'On the Variability of Personal Equation in Transit Observations.' *Amer. Jour. Sci.*, Vol. XLVII, pp. 297-307.

A discussion of interesting experiments.

1869 TODHUNTER. 'On the Method of Least Squares.' *Trans. Camb. Phil. Soc.*, Vol. XI, pp. 219-238.

On page 9 of the First Supplement (1815) or on page 539 of the national edition of the *Théorie... des Prob.*, LAPLACE gave, without demonstration, a certain formula. "The primary object of this communication is to demonstrate the result which as I have stated LAPLACE merely enunciated.... A secondary object of the communication is to develop LAPLACE's own process of investigating the method of Least Squares; some of the results which he obtained for the case of *two* elements are here demonstrated to hold for the case of any number of elements."

1869 WATSON. 'Method of Least Squares, Theory of the Combination of Observations, and Determination of the most probable system of elements from a series of observations.' Chap. VII of his *Theoretical Astronomy* (Philadelphia, 8vo), pp. 360-425.

An elementary sketch of the subject according to GAUSS and ENCKE.

[1869] THIELE. Undersøgelse af Omlobsbevaegelsen i Dobelstjerne.

"THIELE hat gezeigt dass der wahrscheinlichste Werthe bei durch Schätzung ermittelnden Doppelsterndistanzen das geometrische Mittel ist."—HELMERT, *Ausgleichungsrechnung*, p. 95.

1870 CROFTON. 'On the Proof of the Law of Errors of Observations.' *Phil. Trans. London* for 1870, pp. 175-188.

The object of this paper is to determine the law of facility of error on the hypothesis that an error arises from the joint operation of a large number of small sources of error, positive and negative errors *not* being equally probable. The investigation is not very clear.

1870 LAZARUS. 'On some problems in the Theory of Probabilities.' *Lond. Assurance Mag.*, Vol. XV, pp. 244-257.

This is translated from the German. It treats of the general term of the binomial  $(\frac{1}{2} + \frac{1}{2})^m$  when  $m$  is very large.

1870 NEOVIUS. *Lärobok i minsta quadrat-metoden*. Åbo, 8vo, pp. 109.

For review see *Bull. Math. et Astron.*, Vol. II, pp. 134-136.

1870 SANTINI. Compendiato esposizione del modo più vantaggiosa di risolvere una serie di equazioni lineari, risultanti da operationi tutti ugualmente probabili, per la determinazione degli elementi di una proposta teorica. *Mem. Istit. Veneto.*, Vol. XIV.

1870 TCHÉBYCHEFF. 'Formule d'interpolation par la méthode des moindres carrés.' *Mém. Couronnés Acad. Belgique*, Vol. XXI, (Appendix to "N. Majewski, Mémoire..."), 9 pp.

See *Jahrb. Fortschr. Math.*, Vol. II, p. 116.

1870 WOLF. '*Handbuch der Mathematik, Physik, Geodäsie und Astronomie*.' Zürich, 2 vols. 8vo. Vol. I (1870), pp. xii, 492; Vol. II (1872), pp. viii, 459.

This valuable work of reference contains a brief sketch of the history of the Method of Least Squares, with a short development of its theory according to 1832 ENCKE.

1871 ABBE. 'A Historical Note on the Method of Least Squares.' *Amer. Jour. Sci.*, Vol. I, pp. 411-415.

Points out that the Method was independently discovered and published by ADRAIN in 1808, and reprints a portion of the original investigation. Interesting biographical notes relating to ADRAIN are also given.

1871 FRANKE. '*Die Dreiecksnetze vierter Ordnung, als Grundlagen geodätischer Detail-Aufnahmen zu technischer oder staatswirtschaftlichen Zwecken*.' München, 8vo, pp. xii, 261.

Numerous examples of adjustment are given. The theory and practice of the subject are presented in different chapters. It is an excellent book.

1871 GLAISHER. 'Tables of the Error-function.' *Lond. Phil. Mag.*, Vol. XLII, pp. 431-436.

An account of KRAMP'S, BESSEL'S, ENCKE'S and other tables of the values of the probability integral, with a new table of values from  $x=3.00$  to  $x=4.50$ .

1871 JORDAN. Ueber die Genauigkeit einfacher geodätischer Punktbestimmungen. *Zeitschr. für Math. u. Phys.*, Vol. XVI, pp. 397–413.

1871 KLINKERFUES. 'Die Berechnung einer Bahn aus einer grösseren Zahl von Beobachtungen nach der Methode der kleinsten Quadrate.' *Theoretische Astronomie* (Braunschweig, Svo), pp. 328–379.

An elementary sketch of the Method of Least Squares.

1871 MINDING. 'Zur Theorie der kleinsten Quadrate.' *Bull. Acad. St. Péters.*, Vol. XVI, col. 305–308.

On the solution of normal equations, determination of weights, etc.

1871 PETERS. 'Quadrate der Zahlen von 1 bis 10,000.' *Astron. Tafeln und Formeln* (Leipzig, 8vo), pp. 151–169.

Deserves a place here as an aid in the Method of Least Squares on account of its great convenience, being arranged like logarithms.

1871 SCHOTT. 'Method of adjustment of the secondary triangulation of Long Island Sound.' *Rep. Coast Sur. U. S.* for 1868, pp. 140–146.

1871 ZACHARIAE. 'De mindste Quadraters Methode.' Nyborg, Svo, pp. viii, 234.

This is an excellent text-book. See review in *Jahrb. Fortschr. Math.*, Vol. III, p. 95.

1872 DIENGER. 'Ueber einen Satz der Wahrscheinlichkeitsrechnung und damit zusammenhängende bestimmte Integrale.' *Abhandl. Böhm. Gesell.*, Vol. V, 44 pp.

See *Jahrb. Fortschr. Math.*, Vol. IV, p. 89.

1872 GLAISHER. 'Remarks on certain portions of LAPLACE'S Proof of the Method of Least Squares.' *Lond. Phil. Mag.*, Vol. XLIII, pp. 194–201.

The matter of this paper is mostly included in the following.

1872 GLAISHER. 'On the Law of Facility of Errors of Observations, and on the Method of Least Squares.' *Mem. Astron. Soc. Lond.*, Vol. XXXIX, pp. 75–124.

This is perhaps the most valuable of all the theoretical memoirs on our list, presenting as it does clear critical analyses of the principal proofs of the law  $\varphi(x) = ce^{-h^2x^2}$  and of the Method of Least Squares. It has been of great value to me in preparing this list.

ADRAIN's first proof is examined at length and its reasoning shown to be defective. Then are analysed in order: 1. GAUSS's first proof, including ENCKE's, DEMORGAN's and ELLIS's remarks on the arithmetical mean; 2. LAPLACE's method, POISSON's and ELLIS's simplifications and IVORY's criticisms; 3. GAUSS's second demonstration; 4. HERSCHEL's proof, with ELLIS's and BOOLE's criticisms thereon; 5. TAIT's and similar proofs; 6. DONKIN's proof of 1857. By means of the index at the end of this list the reader may refer back to these papers, where I have often quoted GLAISHER's remarks.

It is considered unproved that the arithmetical mean gives the most probable result. GAUSS's second proof is regarded as resting upon an arbitrary assumption, which practically assumes the point to be proved. LAPLACE's method is considered as giving the only correct and philosophical analysis of the question, and this GLAISHER shows leads directly to the exponential law of facility, provided that the sources of error are very great in number and that positive and negative errors are equally likely. "TAIT's proof" is found insufficient. The proofs of 1837 HAGEN, 1838 BESSEL, 1844 DONKIN and 1870 CROFTON are not discussed.

PEIRCE's criterion for the rejection of doubtful observations is regarded as "destitute of scientific precision." "...under no circumstances have we a right to say an observation has no weight, though it may be better to give it none than to give it as much as the best." The method of assigning weights in such cases is hinted at; see below 1873 GLAISHER.

For accounts of the contents of the memoir see *Monthly Notices*, Vol. XXXII, p. 241, and *Jahrb. Fortschr. Math.*, Vol. IV, p. 92.

1872 HELMERT. '*Die Ausgleichungsrechnung nach der Methode der kleinsten Quadrate mit Anwendungen auf die Geodäsie und die Theorie der Messinstrumente*,' Leipzig, 8vo, pp. xi, 348.

The exponential law is regarded as a law proved by experience. The arithmetical mean is said to be the *most plausible* value. Both the first and second proofs of GAUSS are given, and the second is regarded as better and more general.

While the theoretical part of the book is not satisfactory, the practical part renders it valuable for geodetic engineers. Conditioned observations in particular are well treated.

1872 HILGARD. 'An application of an Exponential Function.' *Proc. Amer. Assoc.* for 1871, pp. 61-63.

A certain statute relating to errors in coinage is discussed.

1872 HOPKINSON. On the calculation of empirical formulæ. *Messenger Math.*, Vol. II, pp. 65-67.

A method less accurate than Least Squares.

1872 JORDAN. 'Vergleichung der Genauigkeit verschiedener Gradmessungen.' *Astron. Nachr.*, Vol. LXXX, col. 17-22.

The mean errors of 17 angle measurements and 21 base line measurements are given, the latter for a line one kilometer in length. The greatest mean error of a base line measurement is 63.2 mm. and the least 0.12 mm., the first being measured in 1739 and the second in 1860. This is one of those papers in which the results of long continued research and labor are expressed in a few lines.

1872 JORDAN. 'Ueber die Bestimmung des mittleren Fehlers durch Wiederholung der Beobachtungen.' *Astron. Nachr.*, Vol. LXXIX, col. 219-222.

On the method of deducing probable errors from the  $\frac{1}{2}n(n-1)$  differences of  $n$  measurements, given by him in 1872. See next article.

1872 ANDRÆ. 'Ueber die Bestimmung des wahrscheinlichen Fehlers durch die gegebenen Differenzen von  $m$  gleich genauen Beobachtungen einer Unbekannten.' *Astron. Nachr.*, Vol. LXXIX, col. 257-272.

An investigation of JORDAN's method leading to somewhat different results. See *Jahrb. Fortschr. Math.*, Vol. IV, p. 577, and *Bull. Math. et Astron.*, Vol. IX, pp. 27. See below 1876 HELMERT.

1872 JORDAN. 'Ueber die Bestimmung des Gewichts einer durch die Methode der kleinsten Quadrate bestimmten Unbekannten.' *Zeitschr. Math. u. Phys.*, Vol. XVII, pp. 350-352.

A simplification of demonstrations of two methods.

1872 LORENZ. Udvæjning af Jagttægelses fyl. *Tidsskr. for Math.*, Vol. II, pp. 1- . . , 97, 125, 162.

See *Jahrb. Fortschr. Math.*, Vol. IV, p. 94. The same Journal contains articles by ZACHARIAE.

1872 RUMPEN. 'Ueber den Zusammenhang der von GAUSS begründeten Methode der kleinsten Quadrate mit der algebraischen Theorie der quadratischen Formen.' Bonn, 1872, 8vo, pp. 40.

A doctor's thesis. The conditions for minimum squares, etc., discussed by help of determinants.

1872 SCHLÖMILCH. 'Ueber die Bestimmung der Wahrscheinlichkeit eines Beobachtungsfehlers.' *Zeitschr. Math. u. Phys.*, Vol. XVII, pp. 87-88.

HERSCHEL's proof is taken from 1869 THOMPSON and TAIT, and pronounced "einfache und anschauliche."

1872 WOOLHOUSE. 'On the Philosophy of Statistics.' *Comp. to Almanac* for 1872, pp. 5-22. — *Lond. Assur. Mag.*, XVII, pp. 26-30.

A popular article copied largely from QUETELET.

1872 ZACHARIAE. 'Note betreffend die Bestimmung des mittleren Fehlers.' *Astron. Nachr.*, Vol. LXXX, col. 67-70.

Offers without demonstration a new formula for the mean error of a base line measured in several portions. See 1873 HELMERT and JORDAN.

1873 BROWN. 'On the Application of the Binomial Law to Statistical Enquiries, illustrated by the Law of the Growth of Man at different ages.' *Lond. Assur. Mag.*, Vol. XVII, pp. 340-351.

1873 CROOKES. 'On the Probability of Error in Experimental Research.' *Quart. Jour. Sci.*, Vol. III, pp. 1-13.

Contains some formulæ for weights taken from 1838 DEMORGAN, with an application to determining the probability of error in the atomic weight of thallium.

1873 DEFORD. 'On some Methods of Interpolation applicable to the graduation of irregular Series, such as Tables of Mortality, &c. &c.' *Rep. Smithsonian Inst.* for 1871, pp. 273-339; for 1873, pp. 319-355.

For continuation see below under 1876.

1873 HELMERT. 'Bestimmung des mittlern Fehlers der Längenmessungen aus der Differenzen von Doppelmessungen.' *Astron. Nachr.*, Vol. LXXXI, col. 49-52.

A comparison of the common formulæ with the one given by ZACHARIAE in 1872, showing that the latter is less accurate.

1873 JORDAN. 'Ueber die Berechnung der mittleren Fehlers einer Basismessung.' *Astron. Nachr.*, Vol. LXXXI, col. 51-56.

Also a criticism on ZACHARIAE's formula.

1873 ZACHARIAE. 'Ueber die Bestimmung des mittleren Fehlers einer in mehreren Theilen doppelt gemessenen Grundlinie.' *Astron. Nachr.*, Vol. LXXXI, col. 225-228.

Defends his formula against the above. See *Jahrb. Fortschr. Math.*, Vol. V, p. 127.

1873 JAHN. *Sur la probabilité du tir et la méthode des moindres carrés.* Paris, 8vo.



1873 JORDAN. 'Verallgemeinerung eines Satzes der Methode der kleinsten Quadrate.' *Zeitschr. Math. u. Phys.*, Vol. XVIII, pp. 116-120.

Concerning the solution of normal equations.

1873 JOUFRET. *Sur la methode des moindres carrés et ses applications du tir.* Paris, 8vo.

1873 LAURENT. '*Traité du calcul des probabilités.*' Paris, 8vo. pp. xii, 268.

This is intended as an introduction to the study of LAPLACE'S *Théorie... des Prob.* At the end is the best list of literature on the Method of Least Squares which I have seen.

1873 NEWCOMB. 'A mechanical Representation of a familiar Problem.' *Monthly Notices Astron. Soc. Lond.*, Vol. XXXIII, pp. 573-574.

"Given at several epochs, observed values of a quantity which varies uniformly with the time, to find by Least Squares the most probable values of the two constants which fix its value at any time." The analogy of the question with one of equilibrium in mechanics is pointed out. The solution of a system of linear equations by Least Squares may be represented in a similar way.

1873 PEIRCE (C. S.) 'On the theory of errors of observations.' *Rep. Coast Sur. U. S.* for 1870, pp. 200-224.

Gives an account of some interesting experiments "made to study the distribution of errors in the observation of a phenomena not seen coming on, as in the case of a transit, but sudden as in the case of the emersion of a star from behind the moon." The results are given graphically and show a decided approximation to the exponential law of facility.

In the ten pages of introduction new ideas are offered concerning a notation, "suggested by the study of the logic of relations."

1873 SEELIGER. 'Ueber die JACOBI'sche Auflösung eines Systems von Normalgleichungen mit drei Unbekannten.' *Astron. Nachr.*, Vol. LXXXII, col. 249-252.

See above 1840 BESSEL.

1873 STONE. 'On the most Probable Result which can be derived from a number of direct Determinations of Assumed Equal Values.' *Month. Not. Astron. Soc. Lond.*, Vol. XXXIII, pp. 570-572.

Shows that the arithmetical mean is the most probable results for  $n+1$  observations, provided it is the most probable result for  $n$  observations, and as it is undoubtedly such for  $n=2$ , " ... it can be shown to be generally true."

1873 WREDE. 'Några anmärkningar rörande minste qvadrat-methoden.' *Öfversigt Förhandl. Acad. Stockholm*, Vol. XXX, No. 8, pp. 3-34; No. 10, pp. 21-26.

The probable error is said to be not always 0.6745 of the mean error but depends upon the number of unknown quantities involved. See 1852 BIENAYMÉ. BESSEL's investigation of 1838 is also discussed.

1873 GLAISHER. 'On the Rejection of Discordant Observations.' *Monthly Notices Astron. Soc. Lond.*, Vol. XXXIII, pp. 391-402.

It is here clearly pointed out how inconsistent is the rejection of discordant observations by a criterion founded on the supposition of the validity of the arithmetical mean. The idea first advanced by DEMORGAN (*Encyc. Metrop.*, 1847) that the mean is only an approximate value to be used in weighting the observations from which a new mean is to be deduced, and so on, is here developed to a certain extent. See 1821 —. The criterion given by STONE in 1868 is examined and pronounced untrustworthy and wrong.

1873 STONE. 'On the Rejection of Discordant Observations.' *Monthly Notices*, Vol. XXXIV, pp. 9-15.

A reply to the preceding in which GLAISHER's arguments are examined at length and the validity of the criterion maintained. GLAISHER's method for weighting observations is also discussed and regarded "as mathematically unsound."

1874 GLAISHER. 'Note on a paper by Mr. STONE, "On the Rejection of Discordant Observations."' *Monthly Notices*, Vol. XXXIV, p. 251.

1874 STONE. 'Note on a Discussion relating to the Rejection of Discordant Observations.' *Monthly Not.*, Vol. XXXV, pp. 107-108.

1874 CANTOR. '*Historische Notizen über die Wahrscheinlichkeitsrechnung.*' Halle, 8vo, pp. 8.

This is of no value. GAUSS alone is mentioned in connection with Least Squares.

1874 FECHNER. 'Ueber die Bestimmung des wahrscheinlichen Fehlers eines Beobachtungsmittels durch die Summe der einfachen Abweichungen.' *Poggendorff's Annal. Phys.*, Jubelband, pp. 66-81.

This is an extract from a memoir published in *Abhandl. Sächs. Gesell.*; see below 1875. FECHNER deduces the formula

$$r_0 = \frac{1.195502}{\sqrt{2n - 0.8548}} \cdot \frac{\sum x}{n}$$

$n$  being the number of observations and  $\sum x$  the sum of the residuals all taken positively. See 1876 HELMERT.

1874 GLAISHER. 'On the Solution of the Equations in the Method of Least Squares.' *Month. Not. Astron. Soc. Lond.*, Vol. XXXIV, pp. 311-334.

A critical discussion of GAUSS's, BESSEL's and JACOBI's methods for solving equations and determining weights.—See *Jahrb. Fortschr. Math.*, Vol. VI, p. 145.

1874 HANSEN. 'Von der Bestimmung der Theilungsfehler eines gradlinigen Maassstabes.' *Abhandl. Sächs. Gesell.*, Vol. XV, pp. 525-668.

1874 JEVONS. '*The Principles of Science: a Treatise on Logic and Scientific Method.*' London, 8vo. Vol. I, pp. xvi, 463; Vol. II, pp. vii, 480.

Chapters on 'The Method of Means,' 'The Law of Error,' 'Theory of Approximation,' etc., give valuable remarks concerning the fundamental principles of the Method of Least Squares.

1874 JORDAN. *Taschenbuch der praktischen Geometrie. Eine Sammlung von Resultaten der höheren und niederen Vermessungskunde.* Stuttgart, 8vo, pp. xi, 416.

In Part I the Method of Least Squares is presented. See review in *Schlömilch's Lit. Zeit.*, Vol. XVIII, pp. 33-40. The book is now (1877) being republished under the title '*Elemente der Vermessungskunde*;' and Part I, pp. 1-136, contains a valuable treatise on Least Squares.

1874 MEYER. 'Calcul des Probabilités de A. MEYER, publié sur les manuscrits de l'auteur par F. FOLIE.' *Mém. Soc. Liège*, Vol. VI, No. 2, x+446 pp. —Also published under title *Cours de Calcul.... fait à la Université de Liège....* Bruxelles, 8vo.

This is a comprehensive and valuable work. In the parts relating to the theory of observations the proofs of 1809 GAUSS and 1837 HAGEN are given, as also the investigations of 1852 BIENAYMÉ.

1874 POWALKY. 'On the Combination of the different Results of various Series of Observations.' *Month. Not. Astron. Soc. Lond.*, Vol. XXXIV, pp. 476-479.

1874 SEIDEL. 'Ueber die Berechnung der wahrscheinlichsten Werthe solcher Unbekannten zwischen welchen Bedingungs-Gleichung bestehen.' *Astron. Nachr.*, Vol. LXXXIV, col. 193-210.

The conditional equations are regarded as having infinite weights. This way of consideration appears to lead to a new method of solution.

1874 SEIDEL. Ueber ein Verfahren, die Gleichungen, auf welche die Methode der kleinsten Quadrate führt, so wie lineäre Gleichungen überhaupt, durch successive Annäherung aufzulösen. *Abhandl. Akad. München* for 1874, pp. ....

See *Jahrb. Fortschr. Math.*, Vol. VI, p. 147.

1875 AIRY (W.). 'On the Probable Errors of Levelling; with Rules for the Treatment of Accumulated Errors.' *Proc. Inst. Civ. Engs.* for 1875, pp. .... — *Engineering News*, Vol. IV, pp. 77-78, 84-85, 92, 98-99, 104-105.

A very valuable practical paper.

1875 BAEYER. 'Ueber Fehlerbestimmung und Ausgleichung eines geometrischen Nivellements.' *Astron. Nachr.*, Vol. LXXXVI, col. 177-188.

BESSEL's method for adjusting a triangulation is applied to a connected system of levels.

1875 BELLATI. Intorno ad un modo di semplificare in alcuni casi l'applicazione del metodo dei minimi quadrati al calcolo delle costanti empiriche. *Atti Istit. Veneto*, Vol. I.

1865 BIENAYMÉ. 'Application d'un théorème nouveau du Calcul des probabilités.' *Comptes Rendus Acad. Paris*, Vol. LXXXI, pp. 417-423. — *Bull. Math. et Astron.*, Vol. IX, pp. 219-225.

If a series of observations be arranged in the order of the measurements, there are certain maxima and minima whose probable number and position are given by the theorem. On pp. 458-459, 491-492 of this volume of the *Comptes Rendus* are remarks by BERTRAND on the theorem.

1875 DIENGER. 'Die LAPLACE'sche Methode der Ausgleichung von Beobachtungsfehler bei zahlreichen Beobachtungen.' *Denkschr. Akad. Wien*, Vol. XXXIV, 42 pp.

The method is extended to the case of several unknown quantities. See *Repertorium Math.*, Vol. I, p. 241.

1875 FAYE. 'Note accompagnant la presentation d'une Notice autographiée sur la méthode des moindres carrés.' *Comptes Rendus, Paris.*, Vol. LXXX, pp. 352-356.

The exponential law of error is regarded as an empirical law established by experience.

[1875] FECHNER. Ueber den Ausgangswerth der kleinsten Abweichungssumme, dessen Bestimmung und Verwendung. *Abhandl. Sachs. Gesell.*, Vol. [XVI].

See title 1874 FECHNER.

1875 FRANKE. 'Die trigonometrische Punktbestimmung im Netzausschluss, mit besonderer Rücksicht auf eine rationelle Fehler-Ausgleichung.' München, 8vo, pp. viii, 69.

Reference is here made to articles by TULLA, JORDAN and others on a graphical method of adjustment, whose titles I regret not to be able to give. See *Monatsbl. Badisch. Geom. Vereins* for 1875.

1875 GALTON. 'Statistics by Intercomparison, with Remarks on the Law of Frequency of Error.' *Lond. Phil. Mag.*, Vol. XLIX, pp. 33-46.

If all the men of a tribe were arranged in a row according to their heights, the middle man would have the *mean* height.

The curve  $y = ce^{-h^2x^2}$  is called an "ogive" and it is regarded as more likely to be approximately true of a statistical series than any other that can be specified *a priori*.

1875 HELMERT. 'Ueber die Formel für den Durchschnittsfehler.' *Astron. Nachr.*, Vol. LXXXV, col. 353-366.

The formula given in 1856 by PETERS is discussed, and shown to be correct only for direct observations. A new formula for probable error is proposed. See 1869 LÜKOTH and 1876 HELMERT.

1875 LAURENT. 'Sur la méthode des moindres carrés.' *Licouville's Jour. Math.*, Vol. I, pp. 75-80.

A discussion of 1444 observations to deduce an empirical law of error. The result is that the exponential law represents closely the probabilities of error.

1875 MEES. Ueber die Berechnung des wahrscheinlichen Fehlers einer endlichen Zahl von Beobachtungen. *Zeitschr. Math. u. Phys.*, XX, pp. 145-152.

GAUSS's method (1816) is considered incorrect.

1875 HELMERT. Ueber die Berechnung des wahrscheinlichen Fehlers aus einer endlichen Anzahl wahrer Beobachtungsfehler. *Zeitschr. Math. u. Phys.*, Vol. XX, pp. 300-303.

A reply to MEES's article above.

1875 NATANI. 'Methode der kleinsten Quadrate. Mit den Hauptsätzen aus der Analysis und Wahrscheinlichkeitsrechnung nebst einem Anhang über die ballistische Linie.' Berlin, 8vo, pp. 42.

HERSCHEL's proof is given. The numerical examples concern the probability of striking a target.

1875 SCHIAPARELLI. 'Sur le principe de la moyenne arithmétique.' *Astron. Nachr.*, Vol. LXXXVII, col. 55-58.

A demonstration that the arithmetical mean of direct observations gives "le seul résultat plausible et conciliable avec les exigences pratiques de la question." See 1848 MATZKA, 1868 SCHIAPARELLI and 1876 STONE.

1875 SCHOLS. Over de theorie der fouten in de ruimte en in het platte vlak. *Verhandl. Akad. Amster.*, Vol. XV.

See *Jahrb. Fortschr. Math.*, Vol. VII, p. 114.

1875 SCHOLS. De interpolatie-formule von TCHÉBYCHEF volgens de methode der kleinste vierkanten. *Versl. Akad. Amsterdam*, Vol. IX, pp. 301-311.

1875 SCHOTT. 'Determination of weights to be given to observations for determining time with portable transit instruments, recorded by the chronographic method.' *Rep. Coast Sur. U. S.* for 1872, pp. 222-226.

1875 TILLY. Note sur le principe de la moyenne arithmétique et sur son application à la théorie mathématique des erreurs. *Nouv. Corres. Math.*, Vol. I, pp. 137-147.

See *Bull. Math. et Astron.*, Vol. XII, p. 146.

1875 TILLY. Théorie mathématique des erreurs. *Ballistique*, (Bruxelles, 8vo), pp. 155-225.

The methods of GAUSS, HAGEN and LAPLACE compared. See review in *Jahrb. Fortschr. Math.*, Vol. VII, p. 108.

1875 VAN GEER. Over het gebruik van determinanter by de methode der kleinste kwadraten. *Nieuw Arch.*, Vol. I, pp. 179-188.

1876 BAUERNFEIND. 'Methode der kleinsten Quadrate.' *Elemente der Vermessungskunde* (Stuttgart, fifth edition, 2 vols., 8vo), Vol. II, pp. 4-30.

An elementary sketch of the method.

1876 CHAMBERS (C.) and CHAMBERS (F.). 'On the Mathematical Expression of Observations of Complex Periodical Phenomena; and on Planetary Influence on the Earth's Magnetism.' *Phil. Trans. Lond.*, Vol. CLXV, pp. 361-402.

1876 DEFORREST. 'Interpolation and Adjustment of Series.' New Haven, 8vo, pp. 52.

A supplement to his memoirs of 1873. Besides other valuable matter, methods for finding probable errors of adjusted terms are given.

1876 FERREIRO. *Esposizione del metodo dei minimi quadrati*. Firenze, 8vo, pp. 234.

1876 HAGEN. 'Untersuchungen über die gleichförmige Bewegung des Wassers.' Berlin, 8vo, pp. 104.

All known observations on the mean velocity of rivers are discussed by the Method of Least Squares, and the most probable law and formula for mean velocity are deduced.

1876 HELMERT. 'Die Genauigkeit der Formel von PETERS zur Berechnung des wahrscheinlichen Fehlers directer Beobachtungen gleicher Genauigkeit.' *Astron. Nachr.*, Vol. LXXXVIII, col. 113-132.

Simplifications are given of HELMERT's formula of 1875, and the formulæ of FECHNER, JORDAN and ANDRÄ (see 1869-1874) are discussed.

1867 HELMERT. Ueber die Wahrscheinlichkeit der Potenzsummen der Beobachtungsfehler und über einige damit im Zusammenhang stehende Frage. *Zeitschr. Math. u. Phys.*, Vol. XX, pp. 192-218.

1876 KUMMELL. 'New Investigation of the Law of Errors of Observation.' *The Analyst*, Vol. III, pp. 133-140, 165-171.

HAGEN's proof of 1837 is given abbreviated and improved, and the usual rules for normal equations and probable errors are deduced. The probability to commit no error at all is regarded as an absolute constant. See *Jour. Franklin Inst.*, 1877, Vol. CIV, pp. 270-274.

1876 LÜROTH. 'Vergleichung von zwei Werthen des wahrscheinlichen Fehlers.' *Astron. Nachr.*, Vol. LXXXVII, col. 209-220.

The usual formula is compared with a new formula and shown to give larger values.

1876 SAFFORD. 'On the Method of Least Squares.' *Proc. Amer. Acad.*, Vol. XI, pp. 193-201.

"The main object of this paper is to give rules for good observing derived from this theory." Hints for abbreviating computations are added.

1876 SKINNER. '*Principles of Approximate Computations.*' New York, 12mo, pp. v, 98.

Presents simple rules for conducting computations involving approximate quantities, in such a manner as to require the fewest figures and to show at once the degree of accuracy of the result.

1876 STONE. 'Sur le principe de la Moyenne arithmétique.' *Astron. Nachr.*, LXXXVIII, col. 61-64.

Points out that some of the assumptions of SCHIAPARELLI's proof of 1875 agree with those of his own proof of 1873. The article is in English.

1876 VENN. '*The Logic of Chance. An Essay on the foundations and province of the Theory of Probability, with special reference to its logical bearings and its applications in Moral and Mental Science.*' London, second edition, 8vo, pp. xxvii, 488.

VENN's views are: First, almost any regular and symmetrical method of treating the errors of observation will tend to approximate indefinitely toward the truth as the number of observations is indefinitely multiplied, and this whatever be the law of facility; secondly, the Method of Least Squares is the best method (upon the reasonably probable supposition of the universality of the exponential law), that is, it approximates quicker to the truth as the number of observations is increased than any other method; but its superiority over other reasonable methods is small in comparison with their common superiority over single observations.

'*Jahrbuch über die Fortschritte der Mathematik.*' Berlin, 8vo. One vol. of about 750 pages appears yearly in 3 parts.

This invaluable publication has been of great use to me in preparing the above list for the years 1868-75. Vol. VIII (not yet issued) embracing the literature for 1876, will undoubtedly contain the titles of some writings on the Method of Least Squares which are not given here.



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## ERRATA.

Page 172, line 21 from foot, *for* Remarks *read* 'Remarks.

" 173, " 11 " top, " Jái " J'ai.

" 179, " 8 " foot, " *unbekannten read* unbekannten.

## A D D E N D A.

1876 RÜDIGER. *Die Methode der kleinsten Quadrate abgeleitet aus der Wahrscheinlichkeitslehre, und ihre Anwendung auf naturwissenschaftlichen Messungen.* Frankfurt an der Oder, 8vo, pp. 48.

A doctor's dissertation.

1876 ———. '*Zusammenstellung der Literatur der Gradmessungs-Arbeiten.*' Berlin, 4to, pp. 32.

This is drawn up by commissioners of the states and countries belonging to the European International Geodetic Survey. It contains references to about 380 writings on Geodesy, 200 of which are German, 64 English, 50 Italian and 24 French. The English and Italian literature is well presented, the German and French is not. Coming from such a source, this list should have been a great deal better.

The work is received just as this sheet goes to press, and the following are the additions which it renders necessary to the preceding pages:

The work by BAEYER recorded on page 206 is a lithographed manuscript issued in 1867 or 1868. Two other parts on Geodesy were also published.

The following articles, all relating to the adjustment of geodetic triangulations, should properly have been mentioned in my list: 1865 SCHIAPARELLI, *Istit Lombard. Rend.*, Vol. II, pp. 348-359; Vol. III, pp. 27-41. 1867 WITTSTEIN, *Astron. Nachr.*, Vol. LXIX, col. 289-298; 321-328. 1868 PRONDZYNSKI and BÜRSCH, *Astron. Nachr.*, Vol. LXXI, col. 145-154; 265-268; Vol. LXXV, col. 87-90.

A lithographed manuscript by BAEYER, entitled *Untersuchungen über die Ausgleichung nach Winkel- und Seitengleichungen*, was published in 1871.

### III.—VENTRAL FINS OF GANOIDS. BY JAMES K. THACHER.

Es erscheint als eine allgemeine Regel, dass homodyname, ungleichartig entwickelte Körpertheile an den hinteren Abschnitten indifferenter erscheinen als an den vorderen, dass besonders die Gliedmaassen des Schultergürtels viel reichere Umgestaltungen eingehen als jene des Beckengürtels, an denen sich das ursprüngliche Verhalten länger und vollständiger bewahrt.—*Gegenbaur, Jen. Zeitschr.*, Bd. v, p. 417.

In February last I published a paper\* to show that the limbs with their girdles were derived from a series of similar simple parallel rays, and that they were a specialization of the continuous lateral folds or fins evidenced in embryos, which were with some probability homologous with the lateral folds or metapleura of the adult *Amphioxus*. The following short paper is designed to do little more than corroborate the views there stated.

In Pl. LIX, fig. 64 of that previous paper, an *Acipenser* ventral is exhibited. The ventral of another individual of the same species, *Acipenser brevirostris*, is figured here, Pl. I, fig. 1. Comparing these two we find certain differences. In the first place the number of rays is not the same, being seven in fig. 64 and eight in fig. 1. But we see that the orad ray of fig. 64 is very broad, as it is also in fig. 65, which exhibits the other ventral of the same specimen, and in the text we read "the breadth and outline of *c* (the orad ray) raises a suspicion of its double character." This suspicion, then, is confirmed by the eight rays of fig. 1, where the orad ray is slender like the rest. But there are other differences, and these, aside from insignificant differences in the terminal segmentations, lie in the manner in which the originally separate rays have united with one another. In fig. 64 the aborad three rays are all separate and complete, while in fig. 1 there is quite a different state of things. Here the proximal part of 8 has united with the adjacent part of 7; 7 is free from 6. But the proximal segment of the latter, which is free in fig. 64, is here, in fig. 1, joined to 5. But 5 is free from 4 and 4 from 3 in fig. 1, as is not the case in figs. 64 and 65.

The part *bd* is a large flat piece of cartilage of about the thickness of the rays. The process *b* bends slightly downward (ventrad) and is a little foreshortened in the figure. It approaches its fellow on the other side, but does not unite with it.

\* Median and Paired Fins. Trans. Conn. Acad., Vol. iii, 1877.

There is represented in fig. 1 a peculiar foramen, which either did not exist or was overlooked in the specimen figured in fig. 64. This long tunnel enters the substance of the cartilage from the dorsal side at the place marked *f*, and running in the middle of the cartilage, it pursues the course marked by the dotted line to emerge between the rays 2 and 3.

Its remarkable position, boring the substance of the cartilage to no purpose, and the still more remarkable parallelism between its course and the line of division between rays 3 and 4, are sufficient reasons for regarding it as an indication of an early separation between these two rods 2 and 3. The second foramen *g* proceeds almost directly through the cartilage.

Now if we construct a fin in which all the rays are separate which are separate in either of the two fins figured, and in which the separation between 2 and 3, which is indicated in the way just spoken of, is retained, we shall have a form of fin represented in Pl. I, fig. 2. From evidence then obtained within the limits of this single species, it is proved that there must have been fins of this form possessed by some of the ancestors of these individuals; fins in which each of the eight simple rays maintained its independence and simplicity, except so far as regards the concrescence of the proximal segments 1 and 2, and the process *a* rising from the orad side of the first ray.

*Scaphirhynchus*, as is well known, is the nearest living relative of *Acipenser*, and the two are very similar to one another. The dorsal side of a left ventral of this fish is exhibited in Pl. II, fig. 7. We have here seven rays, but the orad one is so wide as to raise the belief that it has been formed by the union of two. In this the betipping fails. There is the same iliac process *a* growing up from the edge of the fin, but the chief difference lies in the prolongation of the pubic part,\* and the degree of concrescence, which is greater than it is in either of the specimens of *Acipenser* described. As is evident, this fin throws no light on the general question here under discussion. It is a mere modification of the *Acipenser* fin. And to this we return.

We had arrived at a form, Pl. I, fig. 2, consisting of eight simple parallel rays, except that the two orad rays have united in their proximal joints, and that there is the iliac process *a*, and that the

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\* In the figure (Pl. II, fig. 7,) the pubic part, which bends a little ventrad when in position, is here flattened out and not foreshortened. It should be noted that the aborad ray, 7, lies dorsad of the next ray, thus partially concealing it in the figure. This is what we find as a general rule in the ventrals of Elasmobranchs, and the conformation is important in building the intromittent organs of the males.

distal segmentation is wanting on the first ray. If it were not for the process *a*, if here in *Acipenser* we had nothing but the flat piece *b d*, there could, I believe, be no hesitation on the part of anyone in regarding this piece *b d* as formed by concrescence from the rays 1 and 2. But the piece *a* raises an indefinite suspicion. One is led to think that it may possibly be the remains of something, and that despite the apparent similarity, the orad part of the fin may have something more in it than the aborad, and that the part *a* may not be a simple original upgrowth of cartilage dorsad from the orad side of the first ray.

To assure ourselves that it is this last and nothing else we turn to *Polyodon*. A view of the ventral surface of a right ventral is exhibited in Pl. I, fig. 3. Here the number of rays, thirteen, is greater than it was in *Acipenser* and *Scaphirhynchus*. The segmentation into three parts is to be noted, as also the absence of the distal joint in the orad ray, agreeing with what we have found so generally in dorsal, anal and ventral fins. There has been some concrescence, but not very much, as seen in the proximals 12-13 and 1-2-3-4-5. The shortening of ray 7 is worthy of remark. The rays differ a little from those that form the ventrals of *Acipenser* and *Scaphirhynchus*, in that in these latter the rays continue thick to their proximal ends, and the median edge of the fin is quite heavy, whereas in *Polyodon* the proximal ends of the rays become very thin; so that while the distal end of the proximal segment is thick and round, the proximal end runs out into a thin blade. Thus also, as would be expected, the large piece *b d* becomes, as it approaches the median line, a thin lamina of cartilage. This fin lies very nearly all in one plane and there is consequently no foreshortening of any of the parts.

When we turn the fin over so that its dorsal side is presented to view, we see that the structure of the skeleton differs from what it previously appeared to be in a very striking, and as we shall see, significant way. The rods are not simple rods, but from the orad side of the distal part of the proximal segment of *each* ray, a blade-like process runs dorsad, approaching, consequently, a direction at right angles to the plane of the fin, and lying in the intermuscular septa of the fin. One of the rays from the middle of the fin is exhibited in Pl. I, fig. 3, A. The side of the ray is presented, and the process *a'* has been turned about its line of junction with the ray so as to lie in the plane of the paper, and not at right angles to it, as it naturally would. This process *a'* is quite thin and flexible in the case of all the rays of *Polyodon*, while the ray itself at the point where it



sends off this process is thick and heavy. It is, moreover, a real process, a continuation of the cartilage of the ray, and not even articulated with it. The processes are highest in the middle of the fin and diminish in size aborad until they hardly appear on the last two or three rays. Toward the orad extremity of the fin they remain very well developed, though not quite so long as they are in the middle of the fin. One rises at the point marked *a* fig. 3, Pl. I, and others from the plate *b d* at points which would have been the orad sides of the distal ends of the proximal segments 2, 3, 4 and 5 had the proximal segments of those rays not united more or less completely to form the large plate *b d*.

If now we compare this fin of *Polyodon* with that of *Acipenser* and *Scaphirhynchus*, we find that in each there is a process growing dorsad from the place marked *a* in *Polyodon*, Pl. I, fig. 3, and the corresponding points in *Acipenser* and *Scaphirhynchus*, Pl. I, figs. 1 and 2, Pl. II, fig. 3, *a*. There is no difference between the two processes except that of size. The correspondence between the two is so exact that had the species been very different from one another there could have been no doubt of the homology of the process in the one with that in the other, but this is made doubly sure by the fact of the close similarity of *Polyodon* and the Acipenserids.

Again, there can be no doubt of the correspondence, homodynamism, of the first process in *Polyodon* and those that belong to the other rods. They all spring from exactly the same place and differ in size only. We have in *Polyodon* a foot with thirteen toes *where each toe has its own separate ilium*.

It has thus become apparent that the iliac process in the Acipenserids is not a vestige of anything more complex and important; but simply what it was stated to be, a process from the ray, and that the orad part of the fin does not include anything essentially distinct from what appears in the hinder part. We are thus brought to a choice between a series of simple and of forked rays as that from which the Gnathostome limb has been derived. There does not, however, seem to be any room for doubt as to which of these the original form was. That the simpler structure should have been the first produced and that the more complex should have been developed out of this is certainly more consonant with our general experience of organic change than the reverse sequence would have been. Moreover, I have proved that in the similar median fins the original skeletal elements were perfectly simple rods developed in the freely flapping membrane of the fin, and the analogical inference from these to the

paired fins is a strong one, for it is something more than a mere analogy, being supported by causal considerations.

Again, the wide-spread absence of this dorsal process is inconsistent with its constituting a part of each ray of the Protognathostomi or any of their ancestors. Although *Chimæra* has a large iliac process from the orad part of the fin, the Sharks proper, where we might expect to find the skeleton in no very specialized condition, have nothing which seems to represent a dorsal process of any of the rays. Neither do the Holostean Ganoids, nor most, not to say all, of the Teleosts. Among the Batoidei we do have dorsal processes from the pelvic cartilage. Their position renders their strict correspondence with the iliac process of the *Acipenser* fin somewhat improbable, while it suggests the possibility that they may represent some of the processes of the aborad rays of the *Polyodon* fin. Even if this should be the case the absence of these processes in the Sharks would force us to regard the conformation in the Rays and in the Holocephali as having arisen independently of that in *Polyodon*. With this possible exception and the exception of the *Polyodon* ventrals, no ventral fin or limb anywhere shows signs of any forking aborad of the first ray. Nor is there any forking observed in pectoral and median fins except so far as this may be represented in the scapula. It is easier to believe that these comparatively few instances were late, and some of them independent, developments, than to believe that there has been an annihilation, so nearly complete, of dorsal processes which were universal in the beginning.

Thus it seems to me that the order of events, as far as regards the Chondrosteian Ganoids, was like this: The simple ray with the three segments was the early form. An upgrowth of cartilage dorsad from the proximal segment of the first ray took place in the *Acipenserids*. In *Polyodon* this was imitated by the hinder rays. This is an instance of the development of likeness out of unlikeness in homodynamous parts, a kind of change which must have frequently occurred in the history of stocks. It is the opposite of differentiation, and it does not consist in mere reversion to primitive similarity, but in the attainment of similarity in any way. It is exemplified in a department of phenomena resembling somewhat those of biology in the formation of French plurals by the addition of *s*, though the Latin had formed the plurals of the same words in very diverse ways. Thus, too, the close similarity between the fore and hind limb in various forms now living, has doubtless in many cases been preceded by a greater dissimilarity in the direct ancestral lines.

The other Ganoids do not offer us much of interest in their ventral fins, exhibiting as they do only modifications by conrescence, and showing no advance either in the direction of the Dipnoans or the Stapedifera. Figure 1, Plate II, represents the pelvic girdle and rays of *Polypterus*. The fact that the two pubic parts abut on one another without uniting, though fastened together by tough connective tissue, that there is no iliac process and that the whole structure lies in one horizontal plane should be stated. If this fin is compared with that of *Acipenser* and *Scaphirhynchus* there can be no doubt, I think, that the solid pubic pieces in *Polypterus* represent the basal segments of rays, and therefore correspond to the orad proximal parts formed of united rays in *Polyodon* and the Acipenserids. Some one or more of the four rays in *Polypterus* may be composed of more than a single ray. This is not easy to determine, but there is no doubt that they correspond to the middle and terminal parts of the complete tri-segmented ray, and that the terminal segmentations have disappeared as they have in the orad rays of the Chondrostei, and so very generally in the orad rays of Elasmobranch ventral and median fins.

The fins of *Lepidosteus* and *Amia* are not remarkable for much beside their similarity. They are represented in Pl. II, figs. 2 and 3. Comparing them with the fins of *Polypterus* we see that they seem to offer an extension of that same process of reduction which we noticed in that fish. The parts lettered *b d* certainly are homologues of one another in all three. But the middle and terminal segments of the primitive ray, represented by the four well-developed rays of *Polypterus*, are here reduced to the insignificant parts at the extremities of the main portions *b d*. The median one of these small pieces is somewhat produced and ossified. The pubic parts overlap one another but do not join, being merely fastened together by connective tissue. And both in *Lepidosteus* and in *Amia* the overlapping was in the same way, that is, the extremity of the right pubis was dorsad of that of the left. There is no iliac process in either of these forms.

We thus see that in these living Holostean Ganoids the only modification is the reduction in the number of the rays, (and this may be only apparent) and the conrescence especially of the proximal segments. They offer us no advance toward the Dipnoan or Stapediferal limb-skeleton. As to the light which they throw backward on the earlier history, the separation of the pubic part of one side from that of the other and the absence of an iliac process is to be noticed. Otherwise they are uninteresting forms.

Before reviewing the results obtained, I wish to call attention again to the shark ventrals, and to insist on the comparison between them and the Chondrostean ventrals. If the reader will place the figures 1, 2, 3 and 7, side by side with figures 67 and 69 of my paper of last February, or with any of the figures of shark ventrals given by Gegenbaur, there can be no question as to the way in which they are related to one another, and the way in which the latter were formed. If we compare fig. 67 for example, with fig. 3, Pl. I, there can be no hesitation in recognizing the corresponding parts of each; in seeing that the solid "basale metapterygii" of 67 answers to the hinder part of the row of proximals, for the most part separate, of fig. 3, and that the part *bd* in the latter figure represents, more or less exactly, one half the pelvic girdle in the former. The iliac part or parts are not developed in the shark. Thus the most essential difference between the Chondrostean and Elasmobranch, as regards their ventral fins, would be obliterated by that process of concrescence, whose absolute insignificance is shown by the varying degrees in which it shows itself, here in the sturgeon ventrals and elsewhere. I think I may regard the formation of the shark ventrals from a series of three jointed rays in the way exhibited diagrammatically in my former paper, as established fully and finally. It will moreover be observed, that this method of forming the sharks' ventrals, resulting as it did in a "uniserial archipterygium," is incompetent to form a "biserial archipterygium," and that consequently we have in the shark ventral no approach to the *Ceratodus* fin.

*The Relations of the Groups of Gnathostomes and the Modification of the Fin-skeleton in those Groups.*

Views regarding the history of any part or organ determined to a certain extent the views which are held regarding the genealogical connection of the groups in which that part or organ is exhibited; and conversely genealogic connections already established may throw, and usually do throw, a certain weight of evidence for or against a view of the development of an organ. And inasmuch as from the history of one part light is thrown upon the genealogic connection of the groups, and as from this genealogic connection inferences can be drawn respecting the history of other parts, it is evident that in this way the grounds for accepting or rejecting a view of the history of one organ may become the grounds for accepting or rejecting a view proposed for the history of another organ; and be the weight of this evidence great or small, there is no way to bring our belief in one

sequence to bear on that in a different sequence, except by the interposition of a genealogical table more or less complete. And this possibility of making one view confirm another arises, of course, from the fact that, although we may consider the histories of heart, of brain, of skull, or of limb, each by itself, still each heart and limb was only a part of an animal in which were all the other parts.

I therefore here introduce the following views respecting the affinities of the groups involved in this discussion, views in which there is little more original than an independent judgment. I give them without the proof, which is extremely bulky for its weight.

The Gnathostomes and Stapedifera\* are genetic† groups.

The Gnathostomes minus the Elasmobranchs are a genetic group. The nasal fossa is bridged in all the members of this group, with very few and insignificant exceptions.‡ It is never bridged in the Elasmobranchs. We will call the members of this group then Gephyrrhina (*Γέφυρα* = a bridge).

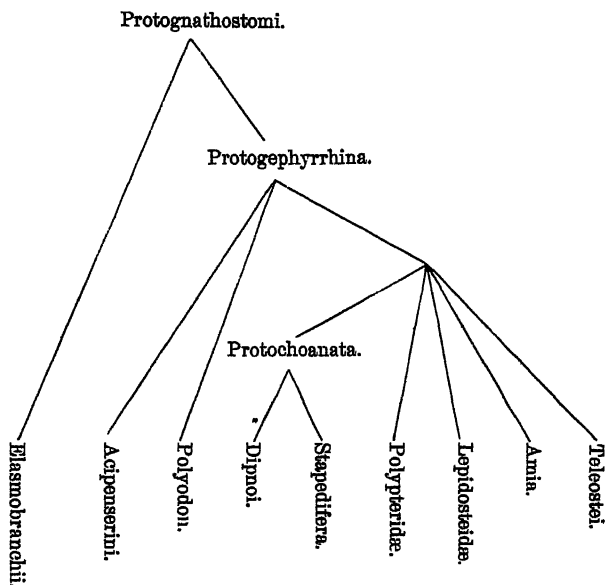
\* Stapedifera = Amniota + Amphibia. In my paper of last February I referred incidentally to the stapes as formed from the proximal part of the hyoid arch. This was a mistake, and my attention was called to it by the following passage from Wiedersheim:—. . . . "so ist es beinahe traditionell geworden, die bei der ungleich besser studirten Entwicklungsgeschichte der Anuren über den Schallzuleitungsapparat gewonnenen Resultate ohne Weiteres auch auf die Urodelen auszuenden. Darauf beruht die in die verschiedensten Abhandlungen und Lehrbücher übergegangene Behauptung: 'das Operculum der Urodelen hat sich vom Hyoidbogen abgeschnürt.'" (R. Wiedersheim, *Kopfskelet der Urodelen*, *Morph. Jahrb.* Band, III, 1877.) Wiedersheim proceeds to show that the stapes or "operculum" of the Urodela is cut out of the cartilage of the periotic capsule as a disk filling the fenestra ovalis, from which a boss, more or less prolonged into a rod in the various species, arises by continuous spreading of the cartilage. He refers to Parker as having arrived at the same results. But it appears that this is only half of the story. Those invaluable memoirs of Parker on the skull, for which every living anatomist must bear a feeling of personal gratitude, seem to establish beyond all reasonable doubt that the stapes of mammals and what corresponds to it in the Stapedifera amammalia is never developed from the hyoid arch; but always from the periotic capsule. Moreover, it appears that in the Batrachia, or tailless Amphibia, and in the Amniota amammalia this periotic stapes connects itself with the proximal part of the hyoid arch to form the columella; and it seems to be proved that this proximal part of the hyoid arch may sometimes originate, ontogenetically, neither in continuity with the distal portion nor at the same time with it.

† By a genetic group I mean an assemblage of animals, or plants, which are more nearly related to one another than any of them is to anything outside the group. Thus the latest common ancestors of any two members of any genetic group would be later than the latest common ancestors of any form in the group and any form outside.

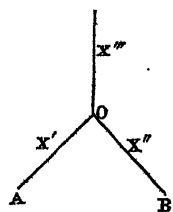
‡ The Chromides, except *Symphysodon*, and the Labroides ctenoidei or Pomacentridæ, have only one external opening on each side. There are also some curious modifications of the olfactory apparatus among the Tetrodontina.

The Stapedifera together with the Dipnoi constitute a genetic group. They have posterior nares, or choanæ, opening within the mouth. We may then call them Choanata.

With a less degree of certainty, I should regard the Elasmobranchii, Teleostei, and Dipnoi, as genetic groups: as also a group formed by withdrawing the Chondrostei from the Gephyrrhina. These relations are exhibited in the following table.



It will be noticed that in two places in this table the division is into more than two lines, into three in one case and into five in the other. I do not intend to indicate that any such multiplicate fission really took place, but merely that it is not yet evident exactly how these sub-groups are related to one another. The relation of the genetic groups A, B, and C may be that exhibited by making C's line come in at X', X'' or X'''. But while it is practically impossible that X should coincide with O, it is very easy for X to get so near O as to be indistinguishable from it, and this will depend principally on the amount of change that has taken place between X and O, and on the completeness of our knowledge of the results of that change as now exhibited in living or fossil forms. To represent the lines as



diverging from O seems a fit way of symbolizing the fact that the point of union of C with the other lines came so near O that in our present ignorance we can not distinguish it from O. And this, I take it, has been the practice hitherto.

From this examination of the Ganoid ventrals have been obtained the following results, for the most part merely confirmatory of views previously expressed.

I. The hind limbs with their arches have been derived from a series of simple rays divided into three segments.

II. The "Archipterygium" never existed outside of the Choanate line, and probably never outside the Dipnoan.

III. While the two former results are well established and may be regarded as final, the views which we must form respecting the number of rays, the amount of concrescence between adjacent rays, the union of the two pubes and the development of the iliac process are much more indefinite and uncertain. It seems probable that there was a reduction in the number of the rays, in going from the Protognathostomi to the Protogephyrrhina, and perhaps a still farther reduction in the line leading off toward the Teleosts. It is not unlikely that the concrescence in each of the ancestral groups just mentioned lay between that of *Scaphirhynchus* and *Polyodon*. The union of the two pubes is found in all Elasmobranchiates, except the Holocephali, in some Teleosts, and in the Dipnoi. Whether this slight development was independent in the different groups where it occurred or not seems at present impossible to say. An iliac process is found in *Chimæra*, in the Rays, in the Chondrostei, apparently in the Dipnoi, and in the Stapedifera; there seems to be the same doubt about the history of this. But it is not very important. The essential fact seems to be this—that the line from the Protognathostomi to the Protostapedifera was in such a state that no very extraordinary set of circumstances was sufficient to evoke an iliac process.

#### INDEX TO PLATES.

[Figures all drawn with a camera.]

##### Plate I.

Fig. 1. Ventral of *Acipenser brevirostris*, from dorsad.

Fig. 2. Partially ideal figure of the same, obtained by combining previous figure with figure 64, Pl. LIX, Trans. Conn. Acad., vol. iii.

Fig. 3. Ventral of *Polyodon folium*, from ventrad. A. Single ray from middle of fin showing iliac process, *a'*.

##### Plate II.

Fig. 4. Ventral of *Polypterus bichir*.

Fig. 5. Ventral of *Lepidosteus osseus*, from dorsad.

Fig. 6. Ventral of *Ambloplites caiva*, from dorsad.

Fig. 7. Ventral of *Scaphirhynchus cataphractus*, from dorsad.

#### IV. SOME INTERESTING NEW DIPTERA. By S. W. WILLISTON.

##### *Rhynchocephalus Sackenii*, n. sp. ♀.

Black with light yellowish hair. Head broader than thorax, brownish black. Front broad, thinly blackish haired on the vertex; the lower part, the face, cheeks, and posterior orbits, with thick, bushy, yellowish white hair, becoming nearly white below. Antennæ short, reddishyellow, base of first joint infuscated, two first joints subquadrate, third circular. Style of three joints, first joint short, yellowish, second joint twice as long, basal half infuscated, third as long as two first, fuscous. Proboscis reaching the hind coxæ, labium black, other parts, with the slender minute palpi, luteous. Dorsum of thorax and scutellum brownish black with yellowish hair; pleuræ and pectus with longer, bushy, grayish white hair. Abdomen short and broad, black; second segment above, and all the segments upon their sides, with yellowish hair, somewhat intermixed with black at the incisures; third and remaining segments above with sparse hairs and thick yellowish tomentum, wanting upon their anterior borders, giving the abdomen a slightly fasciated appearance. Venter with whitish pile. Lamellæ of the ovipositor slender, black, luteous at extreme base, about as long as intermediate femora. Feet luteous. Femora white tomentose, with tufts of hair on their undersides near the coxæ; anterior and middle pairs, for their basal two-thirds, and posterior, except extreme tips, black. Anterior and middle tarsi infuscated, posterior more so, blackish. Wings hyaline; neuration as in the figure:



Adventitious oblique vein but slightly arcuated, terminating beyond the middle of the apical half, not continued to posterior border, so that the third and fifth posterior cells are not completely separated; both cross veins obsolete. Three submarginal cells; first and second open, slender. First posterior open, second closed, the brief petiole terminating in the end of the costal vein before the tip of the wing, fourth (third of Osten-Sacken) closed, as usual; third a little shorter



than fifth. Long. corp. 9<sup>mm</sup>; long. al. 9<sup>mm</sup>. Olympia, Washington Territory,—H. K. Morrison.

The present species is a most interesting addition to our fauna. Hitherto only one, possibly two, species of this family and belonging to the short-proboscid division, have been described from North America. The family is subtropical, and the occurrence of the present, the first North American representative of the rhynchocephalous division (*Nemistrinini*), from such high latitude is remarkable, and, moreover, is a striking example of the resemblance pointed out by Baron Osten-Sacken between the Western Asiatic and our Pacific faunæ. Of the genus *Rhynchocephalus*, Schiner considered *R. Tauscherii*, from the region south of the Black Sea, as the type, and which, evidently, is the only known species, beside the present, that will ultimately remain in the genus, so diverse are the other two species, from the same regions, hitherto placed with it. To *R. Tauscherii* (Meig. Sys. Besch., vol. vi, pl. 66, fig. 6) the present species shows a very close resemblance, the length of proboscis and color of the head being the chief differences.

Of the *Nemistrinini*, a fossil species has been described by Dr. Scudder from the Tertiary shales of Florissant, forming the type of a new genus (*Palembolus*, Bul. U. S. Geol. Sur., vol. iv, No. 2, p. 526). So far as I can judge, the genus is nearly related to *Rhynchocephalus*. I would differ somewhat from Dr. Scudder's excellent interpretation of this, the most intricate neuration among diptera. It is not the anterior, but the posterior, intercalary vein that is present, as in many *Midasidæ*. The vein which he describes as the anterior intercalary, is composed of the anterior basal transverse and the fifth longitudinal. Dr. Loew defined the family as having both intercalary veins, but I can find no evidence of the anterior one.

*Silvius pollinosus*, n. sp. ♀.

Small, black, thickly grayish white pollinose. Head black, shining, concealed beneath dense gray pollen, ocelli very distinct, area not denuded. Frontal callosity black, shining, doubly rounded above, doubly concave and pointed below. Face with three shining black spots, the middle one smaller, sometimes obsolete. Antennæ fuscous, second joint less than half as long as first, basal joint grayish pollinose and black pilose, base of all the joints somewhat luteous, the third especially so on the inner and upper sides, quinque-annulate, terminal portion black. Palpi reddish, proboscis black. Tho-

rax black and shining where denuded of the gray pollen; three indistinct lighter stripes of the color of front, abbreviated posteriorly. Abdomen thickly pollinose, the blackish, opaque ground-color with narrow whitish posterior borders to all the segments; two series of small, median, more or less indistinct, brownish spots on the anterior parts of second, third, and fourth segments; tip thinly whitish pilose. Legs reddish; ends of all the femora and tibiae, anterior tarsi, middle, and posterior tarsi, except the larger part of basal joint, black. Wings pubescent, hyaline; stigma brown, reaching across the marginal cell, veins at bases of second submarginal, first, second, and fourth posterior cells, with narrow blackish clouds; also a number (4-8) of minute brown spots on all the veins beyond the discal cell. Long. corp. 8<sup>mm</sup>. Kansas,—E. W. Guild.

Agrees closely in structure—except the pubescent wings—with *S. gigantulus* Lw., the only other North American species, but is very different in coloration.

#### *Chrysops discalis*, n. sp. ♀.

Large. Front black, with gray pollen, ocellar area not denuded, callosity small, shining-black, oval. Face yellow, with four small black spots, the upper pair broadly, the lower narrowly separated. Antennae: basal joints fuscous, white pubescent, first joint yellow on inner side, third joint black. Palpi the color of the face, white pubescent. Thorax with four cinereous stripes, leaving black intervals, of which the median is narrow. Scutellum cinereous. Abdomen: first segment black, with a small yellow spot on each side of the scutellum; second segment yellowish cinereous with four black spots, the outer ones smaller and posterior, the median ones larger, subquadrate, anterior, narrowly interrupted; third segment with the four spots subequal, indistinct, posterior part and all the remaining segments blackish, with cinereous pollen and yellowish incisures. Venter reddish yellow with three series of black spots, median ones broad and triangular with the base in front, outer ones small, oval; sixth and seventh segments chiefly black with reddish yellow posterior margins. Legs reddish yellow; extreme tips of all the femora, anterior tarsi and tips of other tarsi black, tips of anterior tibiae infuscated. Wings with pale brownish design. End of first basal cell, all of second and third basal cells, anal angle, large spots in the discal and fifth posterior cell and usual crossband, hyaline. Apical portion grayish, with a distinct brown spot at the furcation of the third longi-

tudinal, covering a stump of a vein. Four specimens. Como, Wyoming, June 20. Long. corp. 10–11<sup>mm</sup>.

Belongs in the small Mediterranean group with hyaline discal cell. Easily distinguishable from *C. fulvaster* O. S., of the same region, the only other known American species of this group, by its large size, black frontal and facial callosities and the greater hyalinity of the wings. From *C. quadrivittatus* Say, it is also evidently different.

V. ON THE SPECIES OF PINNIXA INHABITING THE NEW ENGLAND COAST, WITH REMARKS ON THEIR EARLY STAGES. BY S. I. SMITH.

IN the Report of the U. S. Commissioner of Fish and Fisheries for 1871-2, I have figured a species of *Pinnixa* and recorded its occurrence in Vineyard and Long Island Sounds, but referred it incorrectly to *P. cylindrica* (Say sp.) At that time I had examined only three specimens, and all of them were of the species figured. In 1874 and 1875 additional specimens of *Pinnixa* were collected by Fish Commission parties in Fisher's Island Sound, Vineyard Sound, and Buzzard's Bay, but I did not examine them carefully, supposing the specimens to be of the same species as those previously examined. During these seasons, however, I had some opportunities for studying the early stages of the genus.

In 1874 zoeæ of *Pinnixa* were obtained in abundance from the eggs, but I was not able to rear them to later stages. In 1875 zoeæ were again obtained from the eggs and many zoeæ in later stages were taken at the surface. Among those obtained at the surface there were two forms which at first sight looked like two stages of the same species, but on closer examination, they both appeared, judging from the advanced condition of the cephalothoracic and abdominal legs, to be in the last zoea-stage. The larger and much the more abundant of these two forms, the one designated in my notes as the "long-spined zoea," agrees with the zoea of *Pinnixa*, from Newport, Rhode Island, figured by Mr. Faxon (Bull. Mus. Comp. Zool., vol. v, plate 4, figs. 5-15, 1879). The other form, designated in my notes as the "short-spined zoea," is considerably smaller and has very much shorter dorsal and rostral spines, even proportionally shorter than in the first stage of the zoea of *Pinnixa chaetoptera* figured by Mr. Faxon (plate 4, fig. 1), so that the distance from the tip of the dorsal to the tip of the rostral spine is only about half as great as in the long-spined form. Except in these characters I was unable to find any differences whatever and, though then aware of the occurrence of one species only on the New England coast, I supposed that the forms represented two species of *Pinnixa*.

A number of individuals of each form were examined and carefully reared in separate vessels. Two individuals of the long-spined form lived through the last zoea molt and came out in the early stage of the adult form, as well described by Mr. Faxon. Of the short-spined form a single individual was reared through the final zoea molt, and came out a megalops. I was not able during the season of 1875 to rear either the megalops or the young crab through another molt, or to repeat the former observations.

Though these observations were very remarkable, I wished to complete and confirm them, and, if possible, to determine to what particular species the two forms of zoea belonged, and so the publication of the observations was postponed; but no opportunity for completing them occurred, and in 1878 Mr. Faxon, though wholly ignorant of my observations, fortunately repeated the observations upon the long-spined zoea and published the results, together with a brief statement of my observations, and gave figures of the zoeæ which I obtained from the adult *Pinnixa* at Noank, Conn., in 1874. Mr. Faxon identified the adult *Pinnixa*, like those from which the zoeæ were obtained, with *P. chaetoptera* of Stimpson, and, in his paper referred to, is the first to record the occurrence of this species on the New England coast.

During the summer of 1879 Prof. H. E. Webster obtained a large number of specimens of *Pinnixa* (which was before not known north of Cape Cod) at Wellfleet, on Cape Cod Bay, and sent them to me for identification. While examining these I have reexamined the specimens previously obtained on the New England coast, in all between 60 and 70 specimens, and I find there are two quite distinct species among them. As indicated by these collections, by far the most common species is *P. chaetoptera* Stimpson, and among the specimens taken by Prof. Webster in Cape Cod Bay, this is the only species represented. From Vineyard Sound, Buzzard's Bay, and Long Island Sound, however, there are a few specimens of a different species, the one which I have figured and referred to as *P. cylindrica* (Say sp.) It is apparently not Say's species, however, but the species described by Stimpson as *P. Sayana*. Stimpson appears to have had only males and his specimens were dredged in 6 fathoms, off the mouth of Beaufort Harbor, North Carolina. The distinctive features of these two species are pointed out further on.

Having ascertained that the adults of two species of *Pinnixa* inhabit the New England coast, it is a matter of considerable interest to determine whether either or both of these are the same as either

or both of the species which Mr. Faxon and I have observed to differ so widely in regard to the megalops-stage.

The young in the first zoea-stage figured by Mr. Faxon (pl. 4, figs. 1-4) were obtained directly from the eggs of *P. chaetoptera* and are of course unquestionably of that species. That the later stages figured by Mr. Faxon (pl. 4, figs. 5-15, and pl. 5) do not belong to the same species as the young in the first zoea-stage, is shown by the difference in the length of the dorsal and rostral spines in the first and last zoea-stages, and by the presence, in the zoeæ in the first stage, of the central lobe of the posterior margin of the telson, while it is wholly wanting in the zoeæ in the last stage. In the several species of *Brachyura* in which I have examined a series of zoeæ in different stages, the dorsal and rostral spines are proportionally not much if at all longer in the first than in the last stage, and there is often a considerable decrease in the length of these spines in passing from next to the last to the last stage: *Pinnixa* is probably not an exception to this rule. Moreover, among the zoeæ of *Pinnixa* taken in Vineyard Sound in 1875, there are a few specimens of the long-spined form which are evidently in the penultimate zoea-stage, and they agree fully with the numerous specimens in the last stage in the length of the spines and in the form of the telson.

On the other hand the short-spined zoeæ which I observed to pass into a megalops-stage agree with the first stage of the zoeæ from the eggs of *P. chaetoptera*, not only in the length of the spines but also perfectly in the form of the telson, the median lobe of the posterior margin being developed precisely as in the zoeæ of the first stage and as figured by Mr. Faxon (pl. 4, fig. 2, *b*). This is sufficient evidence, I think, to show that the short-spined zoeæ upon which my observations were based are the young of *P. chaetoptera*, and that the long-spined form, which both Mr. Faxon and I observed to pass directly from the zoea to the adult form, must belong to some other species. The fact that these long-spined zoeæ were very common both at Newport and in Vineyard Sound would seem to indicate a probability that they belong to some species regularly inhabiting the coast of Southern New England, and consequently that they are likely to prove the young of *P. Sayana*,—but this is only a probability. That both forms of the early stages belong to species of the same genus (as the genera of the group to which they belong are now understood) there can be no reasonable doubt, since one of the forms has now been traced from the eggs of a well-known species to the megalops-stage, and the other from the later zoea-stages to the early, but generically characteristic, stages of the adult form.

The following systematic account of the two species of *Pinnixa* above referred to gives the obvious specific characters of the adults and the principal bibliography of each species.

***Pinnixa chætopterana* Stimpson.**

*Pinnixa cylindrica* Stimpson, Annals Lyceum Nat. Hist. New York, vii, p. 68 (22) 1859 (partial desc.; South Carolina, in tubes of *Chætopterus*) (*Non* White nec Say sp.)

*Pinnixa chætopterana* Stimpson, op. cit., vii, p. 235 (107), 1860 (desc.; syn.; same loc.) Kingsley, Proc. Acad. Nat. Sci. Philadelphia, 1878, p. 324 (9), 1878 (North Carolina); op. cit., 1879, p. 402, 1880 (Virginia, Florida).

Faxon, Bulletin Mus. Comp. Zool. Cambridge, v, p. 263, pl. 4, figs. 1-4 (zoëa), pl. 5, figs. 8, 9 (chelipeds), 1879 (Long I. Sd. and Buzzard's Bay).

The carapax is very broad and broader in the males than in the females, adult males and large females being two and a fourth times as broad as long. There is a distinct and minutely tubercular ridge along the anterior inferior edge of the branchial region just over the bases of the chelipeds; and above, and nearly parallel with this, there is a denticulated carina, or line of minute denticles, across the swollen branchial region, on a line from the base of the third ambulatory leg toward the eye, but not reaching the lateral margin of the carapax nor crossing the cervical suture, though there is a slight elevation on the hepatic region opposite the carina. This line of denticles is better marked in the females than in the males. The transverse crest upon the cardiac region is conspicuous in both sexes: in the female it is marked by a slender but sharp carina interrupted for about a third its length in the middle; while in the male the carina is even more broadly interrupted in the middle and projects each side in a very prominent, transversely elongated, dentiform protuberance.

In the male the chelipeds are much stouter than in the female: the propodus is nearly smooth, as long as the carapax and somewhat swollen in the middle; the prehensile edge is terminal, but projects distally considerably at the inferior angle, is nearly transverse, and armed with a triangular tooth near the base of the dactylus and usually with a minute one near the tip. The dactylus is stout, very strongly curved and the prehensile edge is nearly or quite smooth. In several of the males examined one of the chelipeds is a little smaller than the other and in all respects like the chelipeds of the female, but these were probably all cases of reproduced limbs.

In the female the chelipeds are smaller and proportionally less stout and more compressed than in the male; the propodus is shorter than the length of the carapax, and the digital portion is oblique, longer than in the male, and its tip is obliquely truncated so as to

leave an angular prominence near the middle of the prehensile edge. The dactylus is much longer and less curved than in the male, and its prehensile edge is armed with a small tooth about a third of the way from the base to the tip, and often with minute additional teeth either side of the principal one.

The first pair of ambulatory legs are slender and scarcely longer than the chelipeds; the second pair are a little longer and considerably stouter, but still slender; the dactyli in both pairs are rather slender, and in the female nearly as long as the upper edge of the propodus, but in adult males apparently a little shorter. The third pair are very large, about equally stout in the two sexes, and in adults about as long as the breadth of the carapax, but in young somewhat longer; the merus is about as long as the carapax and about half as broad as long; the upper edge is angular and usually minutely denticulated distally, there is a slight transverse groove at the distal end, the sides are smooth and rounded, but the inferior edge projects in a thin and conspicuously denticulated carina; there is a similar but much less conspicuous carina upon the propodus and also on the ischium; and there is a slight crest upon the upper edge of the carpus and propodus. The posterior ambulatory legs are short, reaching beyond the merus of the third pair, but they are much stouter than the second pair and the merus is carinated and grooved as in the third pair, though much less conspicuously.

The following measurements of the carapax and one of the third ambulatory legs in a number of specimens show the proportions of these parts of the animal more fully than the description.

No.	Sex.	Carapax:			Third ambulatory leg:			
		Length.	Breadth.	Ratio.	Length.	Merus.	Propodus.	Dactylus.
5	♂	3.9mm	8.7mm	1:2.23	9.4mm	4.0 × 2.0mm	2.0 × 1.4mm	1.2 × 0.3mm
3	"	3.9	8.8	1:2.26	9.5	4.0 2.0	2.0 1.4	1.2 0.4
1	"	4.0	9.1	1:2.27	9.7	4.1 2.1	2.0 1.5	1.3 0.4
3	"	4.1	9.3	1:2.28	9.8	4.2 2.1	2.0 1.5	1.3 0.4
3	"	4.4	10.0	1:2.27	10.5	4.4 2.2	2.2 1.6	1.4 0.5
3	"	4.5	10.2	1:2.27	11.2	4.6 2.3	2.0 1.5	1.4 0.5
5	"	4.7	11.0	1:2.34	11.0	4.7 2.5	2.2 1.8	1.5 0.5
3	"	4.9	11.5	1:2.35	11.0	5.0 2.4	2.3 1.8	1.5 0.6
4	♀?	2.3	4.7	1:2.04	6.0	2.3 0.9	1.3 0.6	1.0 0.2
3	♀	2.6	5.3	1:2.12	6.5	2.6 1.2	1.5 0.9	1.0 0.3
3	"	3.0	6.5	1:2.10	7.4	2.8 1.3	1.7 1.0	1.1 0.3
5	"	3.2	7.0	1:2.19	7.7	3.2 1.7	1.6 1.2	1.1 0.3
5	"	4.6	10.0	1:2.17	10.5	4.1 2.4	2.0 1.5	1.3 0.5
3	"	4.6	10.3	1:2.24	10.4	4.1 2.2	2.0 1.4	1.4 0.5
5	"	5.0	11.4	1:2.28	11.0	4.7 2.4	2.3 1.8	1.6 0.5
3	"	5.3	12.0	1:2.26	12.2	5.0 2.6	2.5 1.7	1.6 0.5



*Specimens Examined.*

No.	Locality.	Fath.	Bot.	When coll'd.	Rec'd from.	No. specimens:			Dry or Alc.
						♂	♀	with eggs	
1	Stony Creek, L. I. Sd.	shore	M., S.	May 15, '71	S. I. Smith	1			Alc.
2	Noank, Fisher's I. Sd.			Aug., 1874	U. S. F. Com.		5	2	"
3	Buzzard's Bay	dredg.		Aug., 1875	"	19	13	1	"
4	Vineyard Sound	surface		Aug. 25, '75	"	young.	2		"
5	Wellfleet, C. Cod B.	shore		1879	H. E. Webster	10	9	1	"

No. 5 were all found in the tubes of *Amphitrite ornata* Verrill (Leidy sp.)

***Pinnixa Sayana* Stimpson.**

*Pinnixa Sayana* Stimpson, Annals Lyceum Nat. Hist. New York, vii, p. 236 (108), 1860 (desc. of ♂; North Carolina).

Kingsley, Proc. Acad. Nat. Sci. Philadelphia, 1878, p. 323 (8), 1878.

*Pinnixa cylindrica* Smith, Invertebrate Animals of Vineyard Sound, Report U. S. Comm. Fish and Fisheries, part i, p. 546 (252), pl. 1, fig. 1, 1874 (Vineyard Sd. and Long I. Sd.) (*Non Say sp. nec Stimpson*).

? *Pinnixa* sp. Faxon, Bulletin Mus. Comp. Zool. Cambridge, v, p. 263, pl. 4, figs. 5-15, pl. 5, figs. 1-7, 1879 (early stages; Newport, Rhode Island).

The carapax is narrower than in *P. chaetoptera*, but still nearly, or even somewhat more than, twice as broad as long. There is a tuberculose ridge along the anterior inferior margin as in *P. chaetoptera*, and above and nearly parallel with it a sharp denticulated carina extending from the base of third ambulatory leg across the branchial region and across the cervical suture to the hepatic region, being most conspicuous at the cervical suture, and separating the dorsal from the nearly perpendicular antero-lateral border of the carapax. In the female there is no carina on the cardiac region, only an obtusely angular ridge separating the flat dorsal from the inclined posterior dorsal region; while in the male (as already described by Stimpson) the ridge is marked by a very slender, but acute, carina not interrupted in the middle.

The chelipeds in the one male examined are unequal, the smaller being in all respects like the chelipeds of the female, while the other (apparently of the normal form for the male) is very much as in the male *P. chaetoptera*, though apparently a little smaller in proportion. The tooth near the base of the digital portion of the propodus is inconspicuous but still clearly discernible.

The first and second pairs of ambulatory legs are long and very slender, the first pair being longer than the chelipeds, and the second considerably longer than the breadth of the carapax. The third pair are only a little longer than the second and proportionally consider-

ably stouter, but very much less stout than in *P. chaetoptera*: the merus is about three times as long as broad, the posterior surface is somewhat rough and granular and there is a minutely tubercular and granular carina on the lower edge, but there is no well marked groove across the distal end; there are two lines of granules along the lower edge of the propodus but no real carina. The posterior legs are very much like the third pair except that they are much smaller, reaching only to the distal ends of the carpi of the third pair. The dactyli of all the ambulatory legs are long, slender and nearly straight.

### Measurements.

No.	Sex.	Carapax.			Third ambulatory leg:			
		Length.	Breadth.	Ratio.	Length.	Merus.	Propodus.	Dactylus.
5	♂	2.8mm	5.4mm	1:1.93	8.0mm	3.2 × 0.9mm	1.7 × 0.6mm	1.5 × 0.2mm
5	♀	2.7	5.2	1:1.94	7.6	2.9 0.8	1.4 0.4	1.4 0.2
5	"	2.9	5.6	1:1.93	7.2	2.7 0.8	1.4 0.5	1.3 0.2
5	"	3.3	6.7	1:2.03	8.2	3.2 1.0	1.6 0.6	1.4 0.3
1	"	3.4	6.8	1:2.00	8.7	3.3 1.1	1.7 0.7	1.5 0.3
4	"	3.7	7.4	1:2.00	9.1	3.8 1.2	1.8 0.7	1.6 0.3
2	"	3.7	7.7	1:2.08	9.0	3.6 1.2	1.9 0.8	1.6 0.3
3	"	4.3	8.7	1:2.02	10.1	4.0 1.4	2.0 1.0	1.7 0.3

### Specimens Examined.

No.	Locality.	Fath.	Bot.	When coll'd.	Rec'd from.	No. specimens:		Dry or Alc.
						♂	♀ with eggs.	
1	New Haven, L. I. Id.	dredged			A. E. Verrill	1	0	Alc.
2	" "	"		1869	A. D. Chidsey	1	0	"
3	" "	shore		May 22, '72	A. E. Verrill	1	0	"
4	Vineyard Sound			1871	U. S. F. Com.	1	0	"
5	Buzzard's Bay	dredged	M.	1875	"	1	3	1

**VI. OCCASIONAL OCCURRENCE OF TROPICAL AND SUB-TROPICAL SPECIES OF DECAPOD CRUSTACEA ON THE COAST OF NEW ENGLAND. BY S. I. SMITH.**

SOME years ago I called attention to the occurrence of the young of a southern species of *Ocypode* on the south shore of Long Island and the coast of southern New England, and more recently Mr. Faxon has recorded the similar occurrence, at Newport, Rhode Island, of *Polyonyx macrocheles* and, incidentally, of *Calappa marmorata*. Since my first observations were published a considerable number of new observations have been made and additional species have been found to occur in a similar way, so that it seemed desirable to bring together all the observations with the view of calling special attention to the subject. This is attempted in the following list which includes all the tropical and sub-tropical species which are known to me to occur, in any stage of the adult form, on the New England coast. The pelagic species which I have mentioned as found near the borders of the Gulf Stream, off St. George's Banks (these Transactions, vol. iii, p. 26; vol. v, pp. 120-122), are doubtless all regular inhabitants of the Gulf Stream even much north of New England, and all probably occur occasionally on the coast of southern New England, but only those which have actually been observed in the bays and sounds along the coast itself are included in the list. Of the species included, *Nautilograpsus minutus*, *Neptunus Sayi*, and *Latreutes ensiferus* belong to the pelagic fauna of the Gulf Stream. The others are all southern species which either drift north in the free-swimming early stages and partially complete their development on our coast, like *Ocypode quadrata* and *Polyonyx macrocheles*, or are accidentally carried north in some stage of the adult form and survive for a short time in summer, like *Pachygrapsus transversus*. I have not intended to include any species which could, in any sense, be regarded as properly belonging to the fauna of the New England coast.

***Ocypode quadrata* J. C. Fabricius.**

*Cancer quadratus* J. C. Fabricius, Entomologia Systematica, ii, p. 439, 1793 (diagnosis; "Habitat in Jamaica Mus. Dom. Banks.")

*Ocypode quadrata* J. C. Fabricius (continued).

- Herbst, Krabben und Krobse, i, p. 257, 1782 (= Fabricius).\*
- Ocypode quadrata* J. C. Fabricius, Supplementum Entomol. System., p. 347, 1798.
- Bosc, Hist. nat. Crust., i, pp. 194, 198, 1802 (*Ocypoda*; = Fabricius).
- Latreille, Hist. nat. Crust. Ins., vi, p. 49, 1803 (= Fabricius).
- Ocypoda albicans* Bosc, Hist. nat. Crust., i, p. 196, pl. 4, fig. 1, 1802 (Carolina coast; the figure is very bad and probably not based on the specimens described in the text, the eye-stalks being prolonged as in *O. ceratophthalma*.)
- Latreille, Hist. nat. Crust. Ins., vi, p. 48, 1803 (= Bosc).
- Ocypode arenarius* Say, Jour. Acad. Nat. Sci. Philadelphia, i, p. 69, 1817.
- M.-Edwards, Hist. nat. Crust., ii, p. 44, pl. 19, figs. 13, 14, 1837 (*Ocypoda arenaria*); Ann. Sci. nat., III, xviii, p. 143 (107), 1852 (*Ocypode arenaria*).
- White, List Crust. British Mus., p. 34, 1847 (*Ocypode arenaria*).
- Gibbes, Proc. Amer. Assoc. Adv. Sci., 3d meeting, p. 180 (16), 1850 (*arenaria*).
- Coues, Proc. Acad. Nat. Sci. Philadelphia, 1871, p. 122 (*arenaria*; North Carolina; habits).
- Von Martens, Archiv für Naturgesch., xxxviii, p. 103, 1872 (*arenaria*).
- Smith, Amer. Jour. Sci., III, vi, p. 67, 1873 (*Monolepis inermis*=megalops-stage); Inverteb. Vineyard Id., Report U. S. Fish Comm., i, p. 545 (251), 534 (240), 1874 (*Ocypoda arenaria*).
- Kingsley, Proc. Acad. Nat. Sci. Philadelphia, 1878, p. 322 (7), 1878 (*Ocypoda arenaria*); op. cit., 1879, p. 400, 1880.
- Ocypoda rhombea* M.-Edwards, Hist. nat. Crust., ii, p. 46, 1837 ("Antilles et Brésil"); Ann. Sci. nat., III, xviii, p. 143 (107), 1852 (*Ocypode*).
- White, List Crust. British Mus., p. 35, 1847 (*Ocypode*; Jamaica).
- Dana, U. S. Expl. Exped., Crust., p. 322, pl. 19, fig. 8, 1852 (Brazil).
- Monolepis inermis* Say, Jour. Acad. Nat. Sci. Philadelphia, i, p. 157, 1817.
- M.-Edwards, Hist. nat. Crust., ii, p. 264, 1837.
- White, List Crust. British Mus., p. 65, 1847.
- Gibbes, Proc. Amer. Assoc. Adv. Sci., 3d meeting, p. 192 (28), 1851.
- Cancer arenarius* Catesby, Nat. Hist. Carolina, ii, pl. 35, 1743.

In 1873 I called attention to the occurrence of the young of this species on the coast of New England and Long Island, and suggested its relation to the *Monolepis inermis* of Say. Since then a great number of the megalops have been taken in Vineyard Sound by Mr. V. N. Edwards, and, early in September, 1875, I took several specimens swimming at the surface in the same region. One of the latter specimens, after being kept alive for some days, buried itself in the sand preparatory to molting, but died before this was fully accomplished. The molting was sufficiently advanced, however, to show

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\* The sign of equality (=), as here introduced after a reference, is used to indicate that the description, mention, or whatever account of the species may be given in the work referred to, is apparently based wholly on the previous account given by the author whose name follows the sign.

clearly the form of the young *Ocypode* within the megalops skin and to establish unequivocally my former conclusion that Say's *Monolepis inermis* is really the megalops-stage of this species of *Ocypode*.

I have examined a very large series of specimens of the adult form of this species from Brazil; St. Thomas; Aspinwall; Nassau, New Providence; Texas; Key West, and Sarasota Bay, Florida; the Bermudas; North Carolina; New Jersey; and the south shore of Long Island: and, between specimens of the same size, I can find no differences which could be regarded as specific, though young specimens differ much from adults, and these differences have probably led to the admission of the two nominal species, *arenaria* and *rhombea*.

This species is evidently the *O. quadrata* of Fabricius: the original description of *Cancer quadratus* agrees in every respect, and the comparison with *C. ceratophthalmus* ("Affinis *C. ceratophthalmo* at oculi simplicibus") and the habitat ought to leave no doubt whatever on this point. DeHaan, however, refers Fabricius' species to a Japan *Sesarma* (*Grapsus* (*Pachysoma*) *quadratus* DeHaan, Fauna Japonica, p. 62, pl. 8, fig. 3), although he had already (op. cit., p. 29) retained it in the genus *Ocypode*. Succeeding authors have failed to restore Fabricius' species to its proper place. Fabricius' *Ocypode rhombea*, of which the habitat was unknown, is certainly not this species, nor of the genus *Ocypode* in the modern sense, as the first line of the diagnosis, "thorace laeniussculo utrinque unidentato," plainly shows. If ante-Linnean names, when occasionally binomial, are to be adopted, then Catesby's *arenarius* may be retained.

When writing the report on the crustacea of Vineyard Sound, I had not been able to consult Fabricius' works, and stated that "the Brazilian species, usually called *rhombea* appears to be identical with ours, and if it is really the *rhombea* of Fabricius, his name should undoubtedly be retained." This remark is quoted verbatim in order to correct Mr. Kingsley's statement (Proc. Acad. Nat. Sci. Philadelphia, 1878, p. 322 (7), 1878) that I say "that our form seems to be identical with the Brazilian one, which is known as *O. rhombea* Fabricius, in which case the name *rhombea* will hold."

### *Grapsus pictus* Lamarck

*Cancer grapsus* Linné, Systema Naturæ, ed. xii, i, p. 1048, 1767; Amoenit. Acad., 2d ed., iv, p. 252, pl. 3, fig. 10, 1788.

Herbst, Krabben und Krebse, i, p. 115, 1782.

J. C. Fabricius, Systema Entomologiae, p. 406, 1775; Entomologia System., ii, p. 438, 1793; Suppl. Entom. System., p. 342, 1798.

**Grapsus pictus** Lamarck (continued).

*Grapsus pictus* Lamarck, *Système Animaux sans Vertèb.*, p. 150, 1801.

Bosc, *Hist. nat. Crust.*, i, p. 202, 1802.

Latreille, *Hist. nat. Crust. Ins.*, vi, p. 69, 1803.

Desmarest, *Consider. Général. Crust.*, p. 130, pl. 16, fig. 1, 1825.

M.-Edwards, *Hist. Nat. Crust.*, ii, p. 86, 1837 (Antilles); *Règne animal de Cuvier*, 3<sup>me</sup> édit., pl. 22, fig. 1.

Gibbes, *Proc. Amer. Assoc. Adv. Sci.*, 3d meeting, p. 181 (17) 1850 (Florida).

Dana, *U. S. Expl. Expd.*, *Crust.*, p. 336, 1852 (Madeira, Cape Verdes, Peru, Paumotu Archipelago, Sandwich Is.)

Saussure, *Revue Mag. Zool.*, II, v, p. 362 (9), 1853 (Mazatlan).

Nicolet, in Gay, *Hist. de Chile, Zool.*, iii, p. 166, 1854 (= *G. ornatus* M.-Edwards).

Stimpson, *Jour. Boston Soc. Nat. Hist.*, vi, p. 466 (26), 1857 (= *G. pictus* De Saussure, but supposed not to be that of Latreille).

Streets, *Proc. Acad. Nat. Sci. Philadelphia*, 1871, p. 240 (no description; Isthmus of Panama).

Miers, *Proc. Zool. Soc. London*, 1877, p. 73 (Galapagos Is.; > *G. altifrons* Stimp.).

Von Martens, *Archiv. Naturgesch.*, xxxviii, 1872, p. 106 (Cuba).

Hilgendorf, *Monatsb. Akad. Wissensch. Berlin*, 1878, p. 807 (Mozambique).

*Grapsus (Goniopsis) pictus* DeHaan, *Fauna Japonica, Crust.*, p. 33, 1835.

*Grapsus strigosus* Brullé, in Barker-Webb et Berthelot, *Hist. nat. Iles Canaries*, *Entomologie*, p. 15, 1835 (no description; = *G. Webbii*, teste M.-Edwards).

? Stimpson, *Jour. Boston Soc. Nat. Hist.*, vi, p. 446 (26), 1857 (= *Goniopsis strigosus* White, in part).

? Hoffmann, *Faune de Madagascar, Crust.*, p. 20, pl. 5, fig. 31, 1874.

*Goniopsis picta* Krauss, *Südafrikan. Crust.*, p. 46, 1843.

? *Goniopsis strigosus* White, *List. Crust. British Mus.*, p. 40, 1847 (in part, probably specimens *d* and *j*, Gulf of California).

*Grapsus maculatus* M.-Edwards, *Ann. Sci. nat.*, III, xx, p. 167 (133), pl. 6 (=pl. 22, *Règne animal de Cuvier, Crust.*), 1853 (Antilles).

Saussure, *Crust. Mexique et Antilles (Mém. Soc. Phys. Hist. nat. Genève, xiv)*, p. 32, 1858 (*G. maculatus* ?).

Stimpson, *Ann. Lyceum Nat. Hist. New York*, vii, p. 229 (101), 1860 (Florida).

Kingsley, *Proc. Acad. Nat. Sci. Philadelphia*, 1879, p. 401 (Santa Cruz, Tahiti).

Hoffmann, *Faune de Madagascar, Crust.*, p. 21, pl. 6, figs. 36-38, 1874.

*Grapsus maculatus*, var. *Pharaonis*, A. M.-Edwards, *Nouv. Arch. Mus. Paris*, ix, p. 285, 1873.

*Grapsus Pharaonis* M.-Edwards, *Ann. Sci. nat.*, III, xx, p. 168 (134), 1853 (Red Sea).

Heller, *Sitzungsb. mathem.-naturw. Classe Akad. Wissensch.*, xliii, p. 362, 1861.

Hoffmann, *Faune de Madagascar, Crust.*, p. 20, pl. 5, figs. 32-35, 1874.

*Grapsus ornatus* M.-Edwards, *Ann. Sci. nat.*, III, xx, p. 168 (134), 1853 (Ochli).

*Grapsus Webbii* M.-Edwards, *Ann. Sci. nat.*, III, xx, p. 167 (133), 1853 (= *G. strigosus* Brullé; Canary Is.)

Stimpson, *Proc. Acad. Nat. Sci. Philadelphia*, 1858, p. 102 (48).

*Grapsus altifrons* Stimpson, *Ann. Lyceum Nat. Hist. New York*, vii, p. 230 (102), 1860 (Cape St. Lucas).

*Pagurus maculatus* Catesby, *Nat. Hist. Carolina*, ii, pl. 36, 1743 (Florida).

The only specimen I have seen from the New England coast is a small one taken alive, in 1877, by Mr. J. M. Blake, in Provincetown Harbor, Cape Cod Bay, from a whaler just in from sea. This specimen differs so much from the adult *G. pictus* of Florida and the West Indies that it might readily be taken for a different species. The carapax is very much narrower proportionally than in adults, and the branchial regions are less swollen. The front and epistome are more like *G. strigosus* than the adult *pictus*: the front is not perpendicular as in the adult but very oblique, the median and lateral protogastric lobes being much less angular in front and much back of the frontal margin itself; the relative proportions of these lobes, however, and the other characters of the areolation of the carapax agree well with adult specimens. A series of young specimens of *G. pictus* from the coast of Brazil shows, by direct gradations in the form of the front and the relative proportions of the carapax, that the small specimen from Provincetown is an immature individual of this abundant tropical species, which, as far as I know, has not before been recorded from the western side of the Atlantic north of Florida and the Bermudas.

In the adult condition this species appears to vary slightly in the height of the front and the character of the frontal lobes, and considerably in coloration, but I can see no reason for regarding the form, from Chili, named *ornatus* by Milne-Edwards, or that, from the Gulf of California, called *altifrons* by Stimpson, as distinct species. I have examined a considerable number of specimens of the typical *pictus* from Bermuda and from Key West, Florida, two large specimens of the *ornatus* from Callao, Peru, and two large specimens of the *altifrons* from La Paz, Lower California; and I find no characters whatever in the form of the carapax, or in the proportions or armament of the chilipeds or ambulatory legs, by which these supposed species can be distinguished. In the coloration of these specimens there is an apparent difference between those from the Atlantic and those from the Pacific, but still not sufficient, I think, to distinguish them even as geographical color varieties. All the specimens appear to have the same pattern of coloration, but in those from the Gulf of California and Peru the red very much predominates, while in Atlantic specimens the yellow markings appear to occupy a larger proportion of the surface. The Atlantic specimens vary much in this respect, however, and the coloration of some of those from Bermuda approaches very nearly that of the specimens from the west coast of America, and I have no doubt that a large series of specimens from

different localities would show a complete gradation between the extremes of coloration.

The following table of measurements shows the variation in the proportions of the carapax due to age, and the complete correspondence in the proportions of specimens of similar size from Bermuda and Key West, on the one hand, and Lower California and Peru, on the other. In order to show more clearly the relative proportions of the carapax, the measurements in the last three divisions of the table are given first in millimeters and then in the unit of the length of the carapax. In regard to the height of the front, which is not given in the table, it may be mentioned that it is absolutely higher in the largest specimen from the Bermudas than in either of the specimens from La Paz.

Locality; sex.	Length of Carapax.	Breadth of Carapax:		
		Greatest.	At anterior angles.	Of front.
<i>a</i>	10.7mm	13.7mm 1.26 lgth.	11.5mm 1.07 lgth.	5.0mm .45 lgth.
<i>b</i>	11.7	14.3 1.22	12.1 1.03	5.3 .45
<i>b</i> ♂	14.5	17.0 1.17	13.8 0.95	6.6 .45
<i>b</i> ♂	16.2	18.9 1.16	14.8 0.91	7.1 .44
<i>b</i> ♀	18.5	21.3 1.15	16.8 0.91	8.0 .43
<i>b</i> ♀	21.0	24.0 1.14	18.4 0.88	8.8 .42
<i>c</i> ♂	37.2	40.5 1.09	29.5 0.79	14.7 .40
<i>d</i> ♂	43.0	47.3 1.10	34.6 0.80	17.0 .40
<i>d</i> ♂	57.0	61.4 1.08	43.0 0.77	22.5 .39
<i>c</i> ♂	67.0	73.8 1.10	47.7 0.71	26.8 .40
<i>e</i> ♂	60.0	65.4 1.09	43.0 0.70	24.0 .40
<i>e</i> ♂	65.0	72.5 1.11	46.0 0.71	26.0 .40
<i>f</i> ♀	59.0	64.0 1.08	41.5 0.70	22.8 .39

*a*, Provincetown, Mass. *b*, Brazil (O. F. Hartt). *c*, Bermuda (G. Brown Goode). *d*, Key West, Fla. (received from Dr. Harrison Allen). *e*, La Paz, Lower California (J. Pedersen). *f*, Callao, Peru (F. H. Bradley).

The geographical distribution of the species is, perhaps, sufficiently indicated by the localities given above in the synonymy.

### *Pachygrapsus transversus* Stimpson.

*Grapsus transversus* Gibbes, Proc. Amer. Assoc. Adv. Sci., 3d meeting, p. 181 (17), 1850 (Florida; said to belong to "*Pachygrapsus* if that be adopted.")

*Pachygrapsus transversus* Stimpson, Ann. Lyc. Nat. Hist. New York, vii, p. 64 (18), 1859; Amer. Jour. Sci., II, xxvii, p. 446, 1859; Ann. Lyc. Nat. Hist. New York, x, p. 113, 1871.

Smith, Report Peabody Acad. Sci. Salem, 1869, p. 91, 1871 (Pacific coast Central America).



**Pachygrapsus transversus** Stimpson (continued).

- Kingsley, Proc. Boston Soc. Nat. Hist., xx, p. 158, 1879; Proc. Acad. Nat. Sci. Philadelphia, 1879, p. 400, 1880 (includes specimens from west coast Central America, but does not make *P. socius* a synonym).
- Goniograpsus innotatus* Dana, Proc. Acad. Nat. Sci. Philadelphia, 1851, p. 249 (3), 1851 (South America); Crust. U. S. Expl. Exped., p. 345, pl. 21, fig. 9, 1852.
- Leptograpsus rugulosus* M.-Edwards, Ann. Sci. nat., III, xx, p. 172 (138), 1853 (Brazil).
- Pachygrapsus innotatus* Stimpson, Proc. Acad. Nat. Sci. Philadelphia, 1858, p. 102 (48), 1858 (Madeira).
- Metopograpsus mineatus* Saussure, Crust. Mexique et Antilles (Mém. Soc. Phys. Hist. nat. Genève, xiv), p. 28, pl. 2, fig. 17, 1858.
- Metopograpsus dubius* Saussure, ibid., p. 29, pl. 2, fig. 16, 1858.
- Pachygrapsus intermedius* Heller, Zool. Bot. Verein Verhandl. Wien, xii, 1862, p. 521 (Brazil); Reise der Novara, Crust., p. 44, 1865.
- Pachygrapsus socius* Stimpson, Ann. Lyc. Nat. Hist. New York, x, p. 114, 1871 (Cape St. Lucas, Panama, Peru).
- Grapsus* (*Leptograpsus*) *rugulosus* von Martens, Archiv für Naturgesch., xxxviii, p. 108, 1872.
- Grapsus* (*Leptograpsus*) *mineatus* von Martens, ibid., p. 109, 1872.
- Pachygrapsus rugulosus* Smith, Trans. Conn. Acad., ii, p. 37, 1869 (= *Leptograpsus rugulosus* M.-Edwards).
- Goniograpsus* (*Pachygrapsus*) *transversus* Lockington, Proc. California Acad. Sci., 1876, p. — (9), 1877 (= *Pachygrapsus transversus* Smith).

Four adult specimens of this species were taken alive from the bottom of a whaler in Provincetown Harbor, September 3, 1879. As far as I am aware, it has not before been recorded north of Florida on our coast. I have also examined a large number of specimens from the following Atlantic Ocean localities: Bermudas (G. Brown Goode, J. M. Jones); Key West (Dr. Harrison Allen); Aspinwall (F. H. Bradley); Brazil (C. F. Hartt). From the Pacific coast I have examined specimens from Gulf of Fonseca (J. A. McNiel); Acajutla and Panama (F. H. Bradley); Païta, Peru (F. H. Bradley, James Orton).

I can find no characters whatever in Dana's figures or description for distinguishing his *innotatus* from Gibbes' *transversus*. Stimpson says the *transversus* is "scarcely to be distinguished from *P. innotatus*, but the carapax is somewhat more convex." In all of the five specimens which I have examined from Brazil, the carapax is slightly less convex than in the majority of those from Florida and Bermuda, but some of the specimens from these latter localities are as little convex as, or even less convex than, the Brazilian specimens. All the unfaded specimens which I have seen from the west coast of

America agree well with Stimpson's description of *P. socius* in wanting the patch of dark color usually present at the bases of the propodal digits of the chelipeds of Atlantic Ocean specimens; but in a large series of Atlantic specimens before me there is very great variation in the extent and intensity of the color upon the chelipeds and other parts of the animal, and some of the specimens from Bermuda, and one of those from Brazil want wholly the dark spot upon the chelipeds. The only other characters Stimpson points out for distinguishing the *socius* are: "the carapax is somewhat narrower, less convex, and more strongly striated; and the frontal region is more depressed and expanded." The impossibility of distinguishing Pacific specimens by the narrowness of the carapax or breadth of the front is fully shown in the table of measurements beyond. The convexity and striation of the carapax vary considerably in Atlantic specimens, and in those examined more than enough to include all the Pacific specimens seen.

Several of the specimens from Bermuda have the branchial regions of the carapax much more convex and swollen than is usual, and the convexity is not always equal on the two sides of the carapax. In at least a part of these specimens this irregularity in the form of the branchial region is due to the presence of a Bopyroid parasite within the branchial cavity, and I think it very probable that Saussure's *mineatus* was based on similar parasited specimens.

Heller compares his *intermedius* with Dana's *innotatus* and *simplex* and says that *innotatus* differs from his species only in having the carpus, as well as the hand, smooth above. Heller had apparently seen no specimens of *innotatus*, which is described as having the carpus "smooth" above (although the figure shows indication of slight corrugation), and depended on this one supposed difference for distinguishing the species. There is, as might be expected, considerable variation in the amount of corrugation upon the carpus, some specimens having the carpus very nearly or quite smooth to the naked eye, though in specimens of considerable size it is usually very distinctly corrugated, and I have no doubt Heller would have identified his specimens with the *innotatus* had he had Dana's specimens for comparison. There is certainly nothing in Heller's description to distinguish his species from ordinary specimens of *transversus* from Bermuda and Florida.

The following measurements of the carapax in a large number of specimens were made with special reference to determining the difference in proportions between Atlantic and Pacific specimens. In

order to give the readiest means of comparison, the breadth and the breadth of the front are given first in millimeters and then, in the same divisions of the table, in units of the length of the carapax.

Locality.	Sex.	Length.	Breadth.	Front.
Bermuda, .....	young.	3.6 <sup>mm</sup>	5.0 <sup>mm</sup> 1.39 lgth.	2.6 <sup>mm</sup> .72 lgth.
" .....	"	4.0	5.5 1.37	2.8 .70
" .....	"	5.1	7.0 1.37	3.8 .74
" .....	♀	5.6	7.8 1.39	4.3 .77
" .....	"	7.4	10.4 1.40	5.7 .77
" .....	"	8.2	11.1 1.35	5.8 .71
Paita, Peru, .....	"	8.5	11.0 1.30	5.9 .69
Acajutla, .....	"	9.8	13.1 1.34	7.2 .73
Provincetown, .....	"	10.1	13.2 1.31	7.2 .71
Florida, .....	"	11.0	15.0 1.36	8.3 .76
" .....	"	11.4	15.9 1.40	8.8 .77
Brazil, .....	"	11.5	15.6 1.36	8.6 .75
Acajutla, .....	"	13.7	18.2 1.33	9.8 .71
Bermuda, .....	"	14.2	19.0 1.34	10.8 .76
Provincetown, .....	♂	6.0	7.9 1.30	4.1 .68
Florida, .....	"	7.0	9.3 1.33	5.0 .71
Provincetown, .....	"	7.5	10.0 1.33	5.0 .67
" .....	"	9.0	11.5 1.28	6.3 .70
Bermuda, .....	"	9.4	12.8 1.36	6.9 .73
Paita, Peru, .....	"	10.0	12.8 1.28	7.0 .70
Bermuda, .....	"	10.5	13.7 1.30	7.6 .72
Panama, .....	"	10.5	13.9 1.32	7.6 .72
Bermuda, .....	"	10.7	14.1 1.32	7.8 .73
Panama, .....	"	10.7	14.2 1.32	7.7 .72
Brazil, .....	"	11.0	14.3 1.30	7.6 .69
Bermuda, .....	"	12.4	16.4 1.32	9.0 .73
Florida, .....	"	12.5	16.3 1.30	8.9 .71
Bermuda, .....	"	13.1	17.2 1.31	9.6 .73
Panama, .....	"	13.8	17.4 1.26	9.8 .71
Brazil, .....	"	14.5	18.2 1.25	10.0 .69
Panama, .....	"	15.2	19.4 1.27	10.6 .70
Brazil, .....	"	15.3	19.7 1.29	10.6 .69
Bermuda, .....	♀	9.2	13.0 1.41	7.1 .77

The limits of variation as shown in the table are found in Atlantic specimens. Considering the considerable variation in the proportions of specimens of about the same size, the differences in this respect between the smallest and the largest specimens measured is surprisingly small. The carapax appears to grow proportionally very slightly narrower with increasing size, as I have noticed in a few other species of Grapsoidea, though the reverse is usually the case in nearly all groups of Brachyura, and is what we should naturally expect from the increase, during the early growth of the animal, in the functional importance of the branchiæ.

The measurements given in the last line in the table are of a parasited specimen with one of the branchial regions considerably distorted.

**Nautilograpsus minutus** Milne-Edwards.

A large male of this common pelagic species of the Gulf Stream was taken at Woods' Holl, Vineyard Sound, September 11, 1877, by V. N. Edwards. Length of carapax, 15.1<sup>mm</sup>; greatest breadth, 14.8; breadth of front between bases of eyes, 9.7; breadth between anterior angles, 13.0.

It has been recorded from the English coast by White, Bell, and others; the Mediterranean, Heller; Cape St. Lucas, Stimpson; Indian Ocean, Milne-Edwards.

*Pinnotheres ostreum* Say is brought north in considerable numbers in oysters from the Chesapeake and, very likely, occasionally survives for a considerable time in oysters planted on the New England coast, but, as far as I can learn, it is never found in native New England oysters or in those which have been planted here for any considerable time. It may, therefore, properly have claim to a place in the list. I have never seen the male on the New England coast. The figure, purporting to represent the male of this species, which I have given in the Report on the Invertebrate Animals of Vineyard Sound, is in reality the figure of the male of *Pinnotheres maculatus*.

**Neptunus Sayi** Stimpson (ex Gibbes).

Young specimens of this common pelagic species of the Gulf Stream were several times taken in Vineyard Sound during August and September, 1875. None of the specimens observed were more than 12 to 15<sup>mm</sup> across the carapax. The megalops of this, or of some closely allied species was taken at the same time.

**Calappa marmorata** Fabricius.

While at Woods' Holl, with the party of the U. S. Fish Commission, in the summer of 1875, I was surprised at the occurrence of a very remarkable megalops evidently an early stage of some species of *Calappa*, though the genus was at the time not known to me to occur, on our coast, north of the Carolinas. Before leaving Woods' Holl, however, Mr. V. N. Edwards informed me that a small crab, unlike any before known to him, had been found the previous season, under stones at low water, on Ram Island near Woods' Holl, by Mr. Benja. Smith. The specimen was brought to me by Mr. Edwards and proved to be a young *Calappa marmorata*, with the carapax 22<sup>mm</sup> long. The shores of the same island and other similar localities were carefully searched, during September, 1875, without finding additional specimens. In 1878, however, Mr. Edwards forwarded

another specimen found at Woods' Holl. These two specimens are very nearly of the same size, the last one being very slightly the larger.

These young specimens, though having most of the essential specific characters of the adult *Calappa marmorata*, yet differ so much that they might readily be mistaken for a distinct species when compared with large specimens. The carapax is much narrower than in the adult, the breadth, including the lateral teeth, being only about a fourth greater than the length. The dorsal surface is more convex and more tuberculose, the tubercles being proportionally much larger and more prominent, giving the carapax a much rougher appearance. In fact the carapax resembles that of *C. convexa* of the west coast of America more than it does the adult *marmorata*, except that it has not the crenulated transverse carinæ above the posterior margin and the similar carinæ upon the teeth of the postero-lateral margin.

The *C. convexa* is sufficiently distinguished from the *marmorata* by these crenulated carinæ, though the proportions of the carapax, which are given by Stimpson as distinctive, are wholly inadequate to distinguish it, as the following table of measurements will show. Stimpson evidently compared small specimens of *convexa* with large ones of *marmorata* without making sufficient allowance for the changes in the proportions of the carapax with increasing size.

In the last division of the following table, the breadth of the carapax is given just in front of the three most posterior teeth of the lateral margin, and the breadth given in each of the last two divisions of the table is given first in millimeters and then in the length of the carapax as a unit.

Locality.	Dry, Alc.	Sex.	Length of Carapax.	Breadth of carapax:	
				Including teeth.	In front of teeth.
<i>C. marmorata.</i>					
Vineyard Id.,-----	Dry		22.0 <sup>mm</sup>	27.0 <sup>mm</sup> 1.23 lgth.	----- <sup>mm</sup> -----lgth.
" "-----	Alc.	♂	22.5	28.4 1.26	25.9 1.15
Bermuda,-----	"	♀	34.3	46.5 1.35	39.8 1.16
Key West,-----	"	♀	47.1	66.0 1.40	57.7 1.22
Edmont Key,-----	"	♀	54.0	78.0 1.44	70.6 1.31
" "-----	"	♂	58.0	84.9 1.46	75.5 1.30
Key West,-----	Dry	♂	69.0	106.3 1.54	92.0 1.33
Brazil,-----	Alc.	♂	73.5	111.0 1.59	95.2 1.30
<i>C. convexa.</i>					
La Paz, L. C.,-----	Dry	♀	54.0	77.2 1.43	70.0 1.30
"-----	"	♂	77.0	115.6 1.50	101.2 1.31
"-----	"	♂	86.0	125.0 1.57	119.0 1.38
"-----	"	♂	88.0	128.0 1.57	122.0 1.38

The megalops-stage of *C. marmorata* is so peculiar that I insert the following description. The length of the carapax is 3.0<sup>mm</sup>; the breadth between the antero-lateral angles, 1.8; greatest breadth, 2.1. The lateral margins of the carapax are considerably expanded over the branchial regions, and the dorsal surface is smooth and strongly convex. The front is broad between the bases of the eyes, tapers to an acute-triangular tip, and is very strongly deflexed so that the terminal portion is perpendicular and the tip on a level with the sternum; the terminal portion is also transversely concave in front, so that, when seen from above, it projects only a little in front of the eyes, and shows a slight emargination in the middle. The eyes are large, the diameter being equal to more than half the breadth of the front between their bases, and project considerably beyond the sides of the carapax. The antennæ are very slender and scarcely longer than the breadth of the front between the bases of the eyes. The external maxillipeds have already assumed the form characteristic of the adult Calappidæ. The chelipeds are short and very stout, and in general form approach strongly those of the adult, but are smooth and unarmed with tubercles or spines, except upon the prehensile edges of the pincers. The merus and carpus are stout and swollen; the body of the propodus is stout and broadly expanded above distally, but the upper edge is smooth and rounded; the digital portion is long, slender, bent downward at nearly a right angle to the rest of the propodus, incurved at the very slender tip, and its prehensile edge slightly tubercular. The dactylus is slender and curved like the propodus, so that the tips of the digits cross when the pincers are closed. The prehensile edge of the dactylus in both chelipeds is armed like the digital portion of the propodus, and in one of the chelipeds there is in addition a stout tooth near the base corresponding to the similar tooth at the base of the dactylus in one of the chelipeds of the adult. The ambulatory legs are small and slender, and the dactylus in the posterior pair is armed at the tip with the three long setæ usually characteristic of these appendages in the megalops-stage. The abdomen is small in proportion to the rest of the animal, tapers very slightly distally, and is strongly convex above. The postero-lateral angles of the second to the fifth segment are prolonged downward into obtuse teeth. The sixth segment is very short, being less than half as long as broad. The telson is as broad as the sixth segment, but shorter than broad and with the posterior margin nearly semicircular. The appendages of the second to the fifth segment of the abdomen are of the usual form and

structure, with large outer and small inner lamellæ. The uropods are small, with a very short base, and a single broad oval lamella which reaches only a little beyond the tip of the telson.

When the megalops is at rest, the abdomen is curved beneath the body, and the chelipeds and ambulatory legs are folded very compactly beneath the carapax.

The specimens examined were all taken at the surface of the water in the evening, August 26 and 27, and September 2, 1875.

***Polyonyx macrocheles* Stimpson (ex Gibbes).**

Mr. Faxon (Bull. Mus. Comp. Zool., Cambridge, v, p. 256, 1879) states that the adult of this species has been detected once, by Alexander Agassiz, under stones on the shore at Newport, R. I. Mr. Faxon also says: on several warm days in August, 1878, the zoeæ of *Porcellana* [*P. macrocheles*] swarmed in the streaks of smooth water on the edge of the tidal currents at the mouth of Narragansett Bay." Alexander Agassiz had previously observed the zoea of this species at Newport (Proc. Boston Soc. Nat. Hist., x, p. 222, 1866). I have never observed any stage of the species in Vineyard Sound or elsewhere on the New England coast. The adult appears to be not uncommon as far north as Beaufort, North Carolina.

*Petrolisthes armatus* Stimpson (ex Gibbes). A small specimen of this species was found in a bottle with other invertebrata collected, by Prof. Verrill and a party of students, at Stony Creek, on Long Island Sound, near New Haven, in the autumn of 1867 or 1868. At the time it was brought in, I suspected, without any good reason, that a stray specimen had been accidentally taken out on the excursion in one of the bottles and, in this way, got mixed with the specimens collected; but now I have little doubt that it was an erratic specimen from much further south. As far as I am aware, the species is otherwise not known north of Florida and the Bermudas.

***Latreutes ensiferus* Stimpson (ex M.-Edwards).**

Several small specimens of this Gulf Stream species were taken at the surface in Vineyard Sound, during August and September, 1875.

**Penæus Brasiliensis** Latreille.

I have never seen specimens of this species from the New England coast, but Professor Verrill tells me that the live specimens of a large *Penæus*, in all probability this species, on exhibition at the New York Aquarium in the autumn of 1877, were said, by the Superintendent of the Aquarium, to have been taken on the Connecticut shore of Long Island Sound. Dr. Stimpson (*Annals Lyceum Nat. Hist. New York*, x, p. 232, 1871) had already recorded its occurrence in a fresh-water creek near Somers' Point, New Jersey, and in the Croton River, Sing Sing, New York, so that there can be little doubt that it occasionally extends to the shores of Long Island Sound. It is apparently common from North Carolina! to Brazil!; it is reported from the west coast of Africa by Miers (*Proc. Zool. Soc. London*, 1878, p. 299), and from the west coast of Central America by Kingsley (*Proc. Acad. Nat. Sci. Philadelphia*, 1879, p. 427, 1880).



VII. ON THE AMPHIPODUS GENERA, CERAPUS, UNCIOLO, AND LEPI-  
DACTYLIS, DESCRIBED BY THOMAS SAY. BY S. I. SMITH.

*The genus Cerapus.*

SAY's description of the structure and habits of his *Cerapus tubularis*, though incomplete and, in regard to some of the structural details, incorrect, certainly indicates a remarkable amphipod very unlike any of the other species which have been referred to the genus. Though described by Say in 1817 from specimens found "amongst fuci on the sea beach at Egg-Harbor [New Jersey] in considerable numbers," it seems to have remained unknown for more than fifty years. It was searched for in vain at the original locality by Professor Verrill and myself in April, 1871, but in June of the same year I dredged a few specimens in Vineyard Sound. These specimens were unfortunately all females, while Say's description and figures were based on the male only, so that I did not feel entirely certain of their identity with Say's species. In the Report on the Invertebrate Animals of Vineyard Sound, I inserted the species under Say's name, with a query, and, after briefly describing the coloration and habits, remarked that, "in the structure of the caudal appendages, our specimens are quite different from the species usually referred to *Cerapus*, but I have not thought best to make any changes in the nomenclature of any of the species until the discovery of the male shall make it certain whether our specimens belong to the species described by Say." In 1874 a considerable number of specimens were taken, in the towing-net, on the evenings of July 17th and 21st, in Noank Harbor, Connecticut, by Professor Verrill, though I was unable to discover a single specimen in the same locality a few days later. Among these specimens collected by Professor Verrill, there are fortunately an abundance of males which agree with Say's description and figure and leave no doubt whatever that the species is the same as Say's. The following description and figures are taken from these specimens.

The general form of the animal is like *Erichthonius difformis* but much more slender, the body being broad, depressed, very slender, and, in the male, tapering slightly and continuously from the head to the telson. The head is shorter than the first and second segments

of the peræon taken together, and in the male about a fourth as long as the entire peræon, but shorter in the female on account of the elongation of the middle segments of the peræon in that sex. There is a slight dorsal carina on the anterior part of the head, and the anterior margin projects in a slight rostrum in the middle, and at the sides in slightly prominent lobes in which the small black eyes are situated. In the lateral margin below the eye there is a large emargination over the base of the antenna as in the allied genera. In the male the seven segments of the peræon are about equal in length, but in the female the first and last are shorter and the fourth and fifth longer than any of the others, the fourth and fifth being each about twice as long as either the first or last. The epimera are all long and low: those of the first four segments are small and inconspicuous; the fifth (Plate IIa, figure 4, *a*) is much larger and projects in a conspicuous, broad and rounded lobe in front of the articulation of the limb; the sixth and seventh are similar in form but successively much smaller.

In the male, the antennulæ and antennæ are approximately equal in length. The antennulæ are slightly more than half as long as the rest of the animal: the first segment of the peduncle is very stout, but compressed laterally and the lower edge raised into a carina which is prominent near the base, where the dorso-ventral diameter is more than half the length of the segment; the second and third segments are sub-equal in length and diameter and each is slightly longer than the first; the flagellum is about as long as the third segment of the peduncle and is composed of three segments, of which the first is rather longer than the second and third taken together. All the segments are furnished with long setiform hairs below and with much fewer and shorter ones above. The antennæ are a very little shorter than the antennulæ and scarcely, if at all, stouter; the third segment of the peduncle is no longer than broad; the fourth is about as long as the second of the antennula; the fifth is a little longer than the fourth; the flagellum is scarcely as long as the fifth segment of the peduncle and is composed of three segments, of which the first is considerably longer than the second and third together. All the segments beyond the third are furnished with setiform hairs very much as in the antennulæ. In the female, the antennulæ and antennæ are proportionally more than a fourth shorter than in the male, the difference resulting mostly from the shortening of the flagella and the distal segments of the peduncles.

The mandibles are nearly as in the *Erichthonius difformis*. The

palpus is slender, and the third segment is about four times as long as broad and a little shorter, but scarcely longer than, the second. The maxillæ are nearly as in *E. difformis*: in the first pair the inner lobe is small and tipped with one or two setæ only;\* in the second pair the two lobes are nearly equally developed. The maxillipeds are essentially as in *E. difformis*.

The gnathopods have essentially the same structure as in *Erichthonius*. The first (Plate IIa, figure 1) are alike in both sexes: the merus is narrow, armed distally with numerous setæ, and its anterior margin articulates with the proximal half of one edge of the triangular carpus; the carpus is nearly as broad as long, the posterior edge is armed with numerous setæ and projects considerably beyond the broad articulation with the propodus; the propodus is as long, but somewhat narrower than the carpus, approximately oval in outline, and thickly armed along the convex posterior edge with setæ and small spines; the dactylus is stout, slightly curved and apparently not capable of complete adduction to the edge of the propodus. The second gnathopods in the female are like the first except that the dactylus is, perhaps, slightly longer. In the adult male, however, the second gnathopods (figure 2) are enormously developed, as in the males of *Erichthonius*. The basis is much stouter but scarcely longer than in the first pair. The ischium and merus are of nearly the same form and size as in the first pair, though the merus is slightly longer. The carpus is more than twice as long and broad as in the first pair: the posterior edge is convex in outline, armed with a few small fasciculi of setæ, and projects distally in a long and stout spiniform tooth; the distal end is very broad, the anterior half only is occupied by the articulation with the propodus, and the edge of the posterior part projects in a prominent obtuse tooth near the base of the propodus, while between this tooth and the great tooth of the posterior angle there is a deep rounded emargination, the border of which is armed with one or two small spines and numerous stout setæ. The propodus is nearly as long as the carpus, about twice as long as broad, slightly curved, and the posterior, or prehen-

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\* Boeck, Christiania Videnskabs-Selskabs Forhandling, 1870, p. 246 (166), and Scandinav. og Arktiske Amphipoder, p. 598, describes the inner lobe of the first maxilla in the Podocerinæ, as destitute of setæ ("lamina interiore parvula, ovali, setis destituta"). This is not characteristic of all the species of the group, however, and will not serve as a character for distinguishing *Cerapus* (as here restricted) from the Podocerinæ; for Boeck himself, in the latter of the works above quoted, plate 28, figure 3f, figures setæ upon this lobe of the first maxilla of *Cerapus* [*Erichthonius*] *abditus*, and they are certainly present in *Erichthonius difformis*.

sile, edge irregular in outline, minutely dentate and armed with setæ. The dactylus is a little shorter than the propodus, stout, but much narrower at base than the distal end of the propodus, regularly curved, and the prehensile edge minutely serrate and armed with a very few minute setæ.

The first and second peræopods are nearly alike and differ only slightly in the different sexes, and, as in the allied genera, are modified for tube-building, the bases being very large and their interiors almost wholly occupied with the cement-glands. In the male the basis in the first pair (Plate IIa, figure 3) is articulated at the anterior angle of the broad and truncated proximal end, while the posterior angle of the same end is prominent and angular. In the second pair the basis is of similar form, but considerably broader in the middle, and the posterior angle of the distal end does not project and is broadly rounded. In both pairs the ischium is a little longer than broad; the merus is of about the same length but broader than long and with both edges convex in outline; the carpus is scarcely as long as the merus and nearly square; the propodus is narrower but nearly a half longer than the carpus; the dactylus is shorter than the propodus and only slightly curved. In the female the basis in the first pair is proportionally broader than in the male, and the posterior angle of the distal end projects in a rounded lobe separated from the rest of the posterior edge by a marked emargination. In the second pair the basis is only somewhat broader and more oval in outline than in the male.

The third, fourth and fifth peræopods are alike in the two sexes and are reversed and turned upward above the back, with the hooked dactyli directed upward and outward. The third pair (Plate IIa, figure 4, *a*, *b*) are very small, being only a little longer than the basis in the third pair, and in the female scarcely longer than the segment to which they belong. The basis makes more than a third of the entire length, is as long as the ischium and merus together and nearly as broad as long. The ischium is very short and broader than long. The body of the merus is ovoid with the proximal end truncate, and has a long, narrow and spatulate process projecting from the posterior edge near the articulation with the ischium and tipped with one short and three long, plumose setæ. The carpus is articulated upon the middle of the posterior side of the merus and near the base of the spatulate process, to which it approaches in size and form; it is tipped with a single seta and the terminal portion is roughened with very minute scale-like teeth pointing distally. The

propodus is about as long and nearly as wide as the body of the merus, is articulated close to the base of the carpus, and armed with a single minute seta on each edge near the distal end. The dactylus is very short and stout, with the solid chitinous tip turned sharply backward and upward in an acute hook and armed with a sharp tooth on the outside at the point of curvature. The fourth and fifth peræopods are slender and of nearly the same form as in *Erichthonius difformis*. The fourth are about once and a half as long as the third, the basis is much broader than the other segments and about a fourth longer than broad; the ischium is small and nearly square; the merus is twice as long as the ischium and very slightly broader; the carpus is not quite as long as the merus but of about the same width; the propodus is about as long as the merus but much narrower; the dactylus is stout and hooked very much as in the third pair; the distal angles of the merus and carpus are armed with long setæ which are longest and most numerous on the posterior distal angle of the carpus, which projects in a small lobe. The fifth pair are a little longer and proportionately a little more slender than the fourth pair, but do not differ in other respects.

There are, apparently, only three pairs of branchial lamellæ, a single lamella being borne upon each coxa of the first, second and third pairs of peræopods.

Of ovigerous lamellæ there are also only three pairs and these are borne upon the coxæ of the second pair of gnathopods and of the first and second peræopods.

The first segment of the pleon is slightly shorter than the seventh segment of the peræon, and the second and third are successively still shorter. The three pairs of pleopods (Plate IIa, figure 5, *a*, *b*, *c*), in marked contrast to those of most Amphipoda, differ remarkably among themselves in the relative proportions of the outer and inner lamellæ, and diminish greatly in size from before backward. This is undoubtedly an adaptation to the position of the animal in its closely fitting tube, with the posterior segments of the pleon bent closely beneath the anterior segments, leaving very little room for the action of the pleopods. In the first pair of pleopods (figure 5, *a*) the base is about as long as the base of the first uropod and more than half as broad as long; the inner lamella is a half longer than the base, narrow, and both margins are furnished with long, plumose setæ; the outer lamella is very little shorter than the inner, narrow distally, but broadly expanding proximally till the breadth is equal to half the length, and then suddenly narrowing to the base; the distal two-

thirds of the inner and the whole of the outer margin are furnished with plumose setæ which are longest at the tip of the lamella and very thickly crowded on the proximal part of the outer margin. The second pair (figure 5, *b*) are very much smaller: the base is little more than half as long as in the first pair; the outer lamella is less than two-thirds as long as in the first pair, ovate, half as broad as long, and both margins are furnished with plumose setæ; the inner lamella is rudimentary, about half as long as the outer and furnished with only two small setæ at the tip and two or three more on the distal part of the inner margin. The third pair (figure 5, *c*) are still smaller: the outer ramus is about two-thirds as long as in the second pair, ovate, and margined with a few plumose setæ distally; the inner is about half as long as the outer, and has only two or three setæ near the tip.

The fourth, fifth and sixth segments of the pleon are much shorter than the first three. As seen from above (Plate IIa, figure 6), the fourth segment is nearly as long as broad; the fifth is a little narrower and not half as long as the fourth, being between three and four times as broad as long; the sixth segment is slightly narrower than the fifth, nearly twice as broad as long, and appears to be partially consolidated with the fifth.

The first pair of uropods (Plate IIa, figure 6) are well developed: the bases are stout and reach to the base of the telson; the outer ramus is narrow, shorter than the peduncle, minutely serrate and sparsely setigerous along the outer edge, and tipped with a slender spine; the inner ramus is smaller than the outer, about three-fourths as long, and tipped with a spine, but the edges unarmed. The second uropods are small, slender and uniramous: the base is about as stout as the outer ramus of the first pair, does not quite reach the base of the telson, and is unarmed; the terminal segment is very short, stout and hooked, and very similar in structure to the terminal segments of the third uropods and the dactyli of the third, fourth and fifth peræopods. The third uropods are like the second, but the bases are much stouter and each is armed with a short seta on the inner edge. The telson is about twice as broad as long and bilobed at the extremity, the lobes being broadly rounded and armed with two or three transverse rows of hooked spines above.

In life, a large portion of the animal appears almost black from the crowding together of numerous specks of very dark purplish pigment. The first segment of the peduncle of the antennula is nearly all colored in this way and there is a broad band of the same character

at the distal end of each of the other segments of the peduncle. The proximal segments of the antenna are also dark-colored, and there is a broad band of color at the distal end of the fourth segment. Other parts of the peduncles of the antennulæ and antennæ are semi-translucent, and so are the flagella. The head and the whole anterior and middle portions of the body of the animal and the epimera are more or less colored in the same way, as are the gnathopods and the bases of the first and second peræopods; but the distal portions of these peræopods, the whole of the third, fourth and fifth pairs, and the caudal appendages are semi-translucent and nearly or quite devoid of pigment.

Two adult specimens give the following measurements :

	Male.	Female.
Length from front of head to tip of telson, .....	4.2mm	4.4mm
Length from front of head to second segment of pleon in natural position of rest, .....	3.5	3.6
Length of antennula, .....	2.4	1.7
Length of tube, .....	5.4	5.5
Diameter of tube at middle, .....	.80	.85

In the largest specimens seen the tubes are about 7<sup>mm</sup> long and 0.9<sup>mm</sup> in diameter, while in the smallest they are only 2<sup>mm</sup> long and 0.45<sup>mm</sup> in diameter.

The tubes of all the specimens seen are black externally, thin, and very regularly cylindrical, except that they are usually slightly enlarged at one or at both ends. Within they are smoothly lined with a layer of cement, while externally they are covered, to a great extent at least, with minute, elongated pellets, apparently the excrement of the animal,\* arranged transversely to the tube and closely

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\* In several allied species of Amphipoda, the excrement enters largely into the composition of the tube. In 1874 I watched carefully the process of constructing the tubes in several species of Amphipoda. *Microdeutopus grandimanus* (M. minax Smith) was a particularly favorable subject for observation. When captured and placed in a small zoophyte trough with small, branching algae, the individuals almost always proceeded at once to construct a tube, and could very readily be observed under the microscope. A few slender branches of the alga were pulled toward each other by means of the antennæ and gnathopods, and fastened by threads of cement spun from branch to branch by the first and second pairs of peræopods. The branches were not usually at once brought near enough together to serve as the frame-work of the tube, but were gradually brought together by pulling them in and fastening them a little at a time, until they were brought into the proper position, where they were firmly held by means of a thick net-work of fine threads of cement spun from branch to branch. After the tube had assumed very nearly its completed form, it was still usually nothing but a transparent net-work of cement threads woven among the

crowded together; there appear, however, to be other materials, probably minute fragments of algæ, hydroids, etc., mixed with the pellets. The tube is apparently never attached, but is carried about by the animal, very much after the manner of the larvæ of some species of Phryganeidæ, as described by Say. It is very difficult to force the living animal from its tube, and it probably never quits the tube voluntarily. The ordinary position of the animal when at rest is with the head only protruding from one end of the tube, the antennulæ stretched out in front and diverging at about a right angle, while the antennæ are held out each side at right angles to the tube. The antennulæ and antennæ are the only appendages which are ordinarily used in locomotion, and by means of these alone the animal appears to move about with its tube with the same ease and rapidity as the species of *Podocerus* and *Corophium* do when unencumbered.

As noticed by Say, the animal turns about within its tube very readily, and uses either end of it indifferently as the front. If the tube catch in any way while the animal is moving about, or if it be held fast by forceps, the head is protruded first from one and then from the other end of the tube in quick succession, and the antennulæ and antennæ are thrust along the outside of the tube to discover the

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branches of the alga, though occasionally a branch of the alga was bitten off and added to the frame-work; but very soon the animal began to work bits of excrement and bits of alga into the net. In this case the pellets of excrement, as passed, were taken in the gnathopods and maxillipeds, and apparently also by the maxillæ and mandibles, and broken into minute fragments and worked through the web, upon the outside of which they seemed to adhere partially by the viscosity of the cement threads and partially by the tangle of threads over them. Excrement and bits of alga were thus worked into the wall of the tube until the whole animal was protected from view, while, during the whole process, the spinning of cement over the inside of the tube was kept up. When spinning the cement threads within the tube, the animal was held in place on the ventral side by the second pair of gnathopods and the caudal appendages, the latter being curved beneath the anterior portion of the pleon, and on the dorsal side by the third, fourth and fifth pairs of pereopods extended and turned up over the back, with the dactyli turned outward into the web. The spinning was done wholly with the first and second pereopods, the tips of which were touched from point to point over the inside of the skeleton tube in a way that recalled strongly the movements of the hands in playing upon a piano. The cement adhered at once at the points touched and spun out between them in uniform delicate threads. The threads seemed to harden very quickly after they were spun and did not seem, even from the first, to adhere to the animal itself. In one case in which the entire construction of the tube was watched, the work was apparently very nearly or quite completed in little more than half an hour. In a species of *Amphithoe*, in which the construction of the tube was watched, the process was very similar, though less cement and more foreign material seemed to enter into the structure.



obstruction. While thus held fast, fully half the body is often protruded from the tube. In turning about within the tube, the terminal segments of the pleon are thrust forward beneath the anterior segments and the peræon pulled back over them, and then the peræon is folded back upon itself in the same way, but the antennulæ, antennæ and head are never first bent beneath the peræon. The structure of the telson, second and third uropods, and of a part of the peræopods is well adapted to the performing of this evolution; the hooks of the second and third uropods and of the telson holding the tail fast to the side of the tube, while the third, fourth and fifth peræopods, holding on with their opposing hooked tips, pull the posterior part of the peræon back over the pleon, and then the first gnathopods help to complete the evolution.

The tubes are usually kept quite free from foreign growths, but among the specimens taken in 1874, there are two individuals in tubes to which are attached the egg capsules of *Tritia trivittata*.

I was not able to discover how the diameter of the tube is enlarged to accommodate the growing animal, but it is probably accomplished by building on a larger portion at one end and pulling to pieces the other end until the whole tube is reconstructed.

As the preceding description shows, this type species of the genus *Cerapus* is generically distinct from the species referred to that genus in recent works, and for which Milne-Edwards' genus *Eriothonius* may properly be retained as explained further on. Say's species is apparently not congeneric with any described species and the genus cannot properly be placed in any of the numerous sub-families defined by Boeck, though it is probably most nearly allied to his Podocerinæ. I therefore propose the following new sub-family to be placed next Podocerinæ.

#### CERAPINÆ.

The single known genus differs from the Podocerinæ and allied groups in the following characters. There are only three pairs of branchial lamellæ, which are borne on the third, fourth and fifth segments of the peræon, and only three pairs of ovigerous lamellæ, which are borne on the second, third and fourth segments. The second and third pleopods are much smaller than the first, and their inner lamellæ are rudimentary or very small. The second and third uropods are uniramus and nearly alike, the distal segment in each being short and terminating in a hooked point.

The only known species inhabits unattached, portable tubes, and, as in many allied genera, has large cement glands in the bases of the first and second peræopods.

### *Cerapus* Say.

- Say, Jour. Acad. Nat. Sci. Philadelphia, i, p. 49, 1817 (*tubularis* the only species.)  
 Desmarest, Dictionnaire Sci. nat., xxviii, p. 358, 1823 (=Say).  
 Latreille, in Cuvier, Règne animal, iv, p. 122, 1829 (=Say.)  
 Milne-Edwards, Ann. Sci. nat., Paris, xx, p. 383, 1830 (=Say); Hist. nat. Crust., iii, p. 60, 1840 (in part).  
 Dana, Amer. Jour. Sci., II, viii, p. 139, 1849, and xiv, p. 309, 1852 (=Say); Crust. United States Expl. Expd., p. 832, 1853 (=Say).  
 Bate, Catalogue Amphip. Crust. British Mus., p. 262, 1860 (in part).

### *Cerapus tubularis* Say.

- Say, Jour. Acad. Nat. Sci. Philadelphia, i, p. 50, pl. 4, figs. 7-9, 1817.  
 Desmarest, Dictionnaire Sci. nat., xxviii, p. 358, pl. 46, figs. 2a-2e (after Say), 1823 (=Say); Consid. génér. Crust., p. 271, pl. 46, figs. 2a-2e (=last), 1825 (=Say).  
 Audouin, Précis d'Entomologie, pl. 28, figs. 5-7 (after Say), 1828 (=Say).  
 Guérin, Iconographie du Règne animal, Crust., pl. 27, fig. 4, (after Say).  
 Milne-Edwards, Règne animal de Cuvier, 3<sup>me</sup> édit, pl. 61, fig. 5-5c (after Say), 1837; Hist. nat. Crust., iii, p. 60, pl. 29, fig. 15 (after Say), 1840 (=Say).  
 Bate, Catalogue Amphip. Crust. British. Mus., p. 262, pl. 45, fig. 1 (after Say), 1862 (=Say).  
 Smith, Inverteb. Animals Vineyard Sound, Report U. S. Comm. Fish and Fisheries, part i, p. 565 (271), 1874.

### PLATE IIa.

Great Egg-Harbor, New Jersey (Say). Vineyard Sound, among masses of a large compound ascidian (*Amouroucium pellucidum*), in 8 to 10 fathoms, off Nobska Point, June 27, 1871; several females, some of them carrying eggs. Vineyard Sound, 1875; one specimen. Taken in the towing net, among eel-grass (*Zostera*), in Noank Harbor, Connecticut, July 17 and 21, 1874 (A. E. Verrill); males, females, and young, many of the females carrying eggs.

The genus *Cerapus* being restricted to the type species and removed from the Podocerinæ, as above, Milne-Edwards' *Erichthonius* appears to be the proper name to restore and retain for the group of species referred to *Cerapus* by recent authors.

### *Erichthonius*.

- Erichthonius* M.-Edwards, Ann. Sci. nat., Paris, xx, p. 382, 1830 (*difformis* the only species); Hist. nat. Crust., iii, p. 59, 1840 (*difformis* only).  
 Dana, Amer. Jour. Sci., II, viii, p. 138, 1849, and xiv, p. 309, 1852; U. S. Expl. Expd., Crust., p. 832, 1853 (*Erichthonius*).

*Erichthonius*—(continued).

- Bate, Report British Assoc. Adv. Sci., 1855, p. 59, 1856 (*Erichthonius*); Ann. Mag. Nat. Hist., II, xix, 149 (17), 1857.
- White, Popular Hist. British Crust., p. 196, 1857.
- Liljeborg, Öfversigt Vetenskaps-Akad. Förhandlingar, Stockholm, 1855, p. 131.
- Costa, Amphipodi Napoli, Mem. Accad. Sci. Napoli, I, pp. 175, 227, 1856.
- Bruzellius, Scandinav. Amphipoda Gammaridea (Vetenskaps-Akad. Handlingar, Stockholm, iii), p. 17, 1859 (*Erichthonius*).
- Cerapodina* M.-Edwards, Hist. nat. Crust., iii, p. 62, 1840 (*abditus* (= *Cerapus abditus* Templeton) the only species).
- Dana, Amer. Jour. Sci., II, viii, p. 139, 1849, and xiv, p. 309, 1852; U. S. Expl. Expd., Crust., p. 832, 1853.
- Podocerus* Krøyer, Naturh. Tidsskrift, iv, p. 163, 1840 (in part).
- Derochoes* Dana, Amer. Jour. Sci., II, xiv, p. 313, 1852; U. S. Expl. Expd., Crust., p. 911, 1853.
- Pycchilus* Dana, Amer. Jour. Sci., II, xiv, p. 313, 1852; U. S. Expl. Expd., Crust., p. 911, 1853.
- Cerapus* Bate, Catalogue Amphip. Crust. British Museum, p. 262, 1860 (in part).
- Bate and Westwood, British Sessile-eyed Crust., I, p. 452, 1863.
- Czerniawski, Materialia ad Zoographiam Ponticam comparatam, p. 97, 1868.
- Boeck, Christiania Videnskabs-Selskabs Forhandlingar, 1870, p. 250 (170); Scandinav. og arktiske Amphip., p. 611, 1876.

The synonymy of *E. difformis*, the type of the genus, is apparently still in confusion, and as it is a common species upon the coast of northern New England, I subjoin the following account of it :

*Erichthonius difformis* Milne-Edwards.

- Erichthonius difformis* M.-Edwards, Ann. Sci. nat., Paris, xx, p. 382, 1830; Hist. nat. Crust., iii, p. 60, pl. 29, figs. 12, 13, 1840.
- Liljeborg, Öfversigt Vetenskaps-Akad. Förhandlingar, Stockholm, 1855, p. 129.
- ? Costa, Amphipodi Napoli, Mem. Accad. Sci. Napoli, I, p. 228, 1856.
- Bruzellius, Scandinav. Amphipoda Gammaridea (Vetenskaps-Akad. Handlingar, Stockholm, iii), p. 17, 1859 (*Erichthonius*).
- Goes, Öfversigt Vetenskaps-Akad. Förhandlingar, Stockholm, 1865, p. 552 (*Erichthonius*).
- Podocerus Leachii* Krøyer, Naturh. Tidsskrift, iv, p. 163, 1840 ("Femina hujus speciei forma pedum secundi paris Podocerus est, mas vero Erichthonius").
- Cerapus rubricornis* Stimpson, Inverteb. Grand Manan, p. 46, pl. 3, fig. 33 (caudal appendages), 1853.
- Bate, Catalogue Amphip. Crust., British Museum, p. 265, pl. 45, fig. 4 (young ♂), 1862 (Bay of Fundy).
- Packard, Memoirs Boston Soc. Nat. Hist., I, p. 297, 1867 (*C. rubiformis*).
- Smith, Inverteb. Animals Vineyard Sound, Report U. S. Comm. Fish and Fisheries, part I, p. 565 (271), pl. 4, fig. 18, 1874.
- Smith and Harger, Trans. Conn. Acad., iii, pp. 5, 19, 1874.
- Podocerus punctatus* Bate, Ann. Mag. Nat. Hist., II, xix, p. 148 (17), 1857 ("P. punctatus (Edwards, MS. Brit. Mus.)").

*Eriethonius difformis* Milne-Edwards—(continued).

*Dereothoe* (*Cerapus*) *punctatus* Bate, Catalogue Amphip. Crust. British Museum, p. 260, p. 44, fig. 10, 1862 (♀).

*Dereothoe* (*Cerapus* ♀) *punctatus* Bate and Westwood, British Sessile-eyed Crust., i, p. 461 (fig.), 1863 (♀). ["Milne-Edwards, MS. in Brit. Mus." is quoted as authority for the name as here used.]

? Czerniavski, Materialia ad Zoographiam Ponticam comparatam; p. 96, 1868.

*Cerapus difformis* Bate, Catalogue Amphip. Crust. British Museum, p. 265, pl. 45, fig. 5, 1862.

Bate and Westwood, op. cit., p. 457 (figs.), 1863.

Norman, Report British Assoc. Adv. Sci., 1868, p. 283, 1869.

Metzger, Jahresbericht der Comm. zur wissenschaftl. Untersuchung der deutschen Meere für 1872-3, Nordsee, p. 278, 1875.

Boeck, Christiania Videnskabs-Selskabs Forhandlinger, 1870, p. 250 (170); Scandinavian. og arktiske Amphip., p. 615, 1876.

Meinert, Naturh. Tidsskrift, III, xi, p. 157, 1877.

*Cerapus Leachii* Bate, Catalogue Amphip. Crust. British Museum, p. 268, 1862 (= Kröyer).

*Cerapus Hunteri* Bate, Catalogue Amphip. Crust. British Museum, p. 264, pl. 45, fig. 3, 1862 (habitat unknown).

Boeck, Christiania Videnskabs-Selskabs Forhandlinger, 1870, p. 252 (172), 1871 (Scandinavia); Scandinavian. og arktiske Amphip., p. 618, pl. 28, fig. 5, 1876.

Vineyard Sound!, 1871, not common. Off Cape Cod!, 29 fathoms, 1879. Stellwagen's Bank! and Jeffrey's Ledge!, 1873. George's Banks!, 50 fathoms, sand and shells, and 45 fathoms, coarse sand, 1872. Casco Bay!, 9 to 34 fathoms, 1873; common. Bay of Fundy!, low-water mark to 50 fathoms, abundant, especially on hard bottoms, 1868, 1870, 1872, 1876; and, in 1872, off Head Harbor, 77 fathoms, mud and stones; and off White Head, Grand Menan, 97 to 105 fathoms, gravel and stones. Halifax, Nova Scotia!, 16 fathoms, rocky, 1877. Straits of Belle Isle, Labrador, (Packard). Spitzbergen, (Goës). Scandinavia, (Kröyer, Liljeborg, Boeck, et al.) British Isles!, (Norman). Brittany, France, (M.-Edwards). It is reported from the Mediterranean by Costa, and from the Black Sea by Czerniavski, (as Bate's *Dereothoe* (*Cerapus* ♀) *punctatus*), but these identifications are, perhaps, erroneous.

The form of the second pair of gnathopods of the adult male varies very much in different specimens. When farthest differentiated from the form characteristic of the female and young, the carpus is triangular, and the spine of the inferior margin very long and separated from the propodal articulation by a deep, triangular sinus, while the propodus is slender, nearly cylindrical, and without prominences on the inferior edge. This is the form which I have figured in the work above referred to, and is apparently very near that figured by Milne-

Edwards as the original *E. difformis*. It is probably the form characteristic of the old males, though the individuals are often smaller than those with the second gnathopods in the less differentiated condition, in which the body of the carpus is more nearly quadrangular in outline, the spine arising near the propodal articulation, and the propodus shorter and stouter than in the other form and with two conspicuous prominences on the inferior edge. This is the form described as *Cerapus Hunteri*, by Bate and by Boeck. In the large series of specimens before me, there is every gradation between these two forms, and between the latter and the female. In one case, an individual had one of the second pair of gnathopods in the most differentiated form, while the other was somewhat smaller and in the less differentiated form—evidently having been lost and reproduced. The only European specimens which I have examined were received from the Rev. Mr. Norman, and are from the Northumberland coast, England, and among these all the adult males agree better with the *Hunteri* than with the more differentiated form.

The habit of the animal and the character of the tubes are well described by Stimpson. In life, the proximal parts of the flagella of the antennulæ and antennæ are bright red, and the color usually remains for some time in specimens preserved in alcohol.

### *The genus Unciola.*

#### Unciola Say.

*Unciola* Say, Jour. Acad. Nat. Sci. Philadelphia, i, p. 388, 1818 (*irrorata* the only sp.)

Milne-Edwards, Ann. Sci. nat., Paris, xx, p. 383, 1830 (= Say).

Dana, Amer. Jour. Sci., II, viii, p. 139, 1849, and xiv, p. 309 (> *Glaucanome*); U. S. Expl. Exped. Crust., p. 832, 1853.

Bate, Catalogue Amphip. Crust. British Museum, p. 279, 1862 (> *Glaucanome*).

*Glaucanome* Krøyer, Naturh. Tidsskrift, II, i, pp. 491–501 (*leucopis* the only sp.)

Boeck, Christiania Videnskabs-Selskabs Forhandling, 1870, p. 259 (179); Scandinavianiske og arktiske Amphip., p. 636, 1876.

"*Cyrtopium* Danielssen, Beretning om en zoologisk Reise, 1857, Nyt Magaz. Naturvidensk., xi, p. 8, 1861," (Boeck).

Krøyer's name *Glaucanome* is not only more recent than Say's *Unciola*, but it had been used at least twice before Krøyer employed it, once in mollusks and once in polyps.

#### *Unciola irrorata* Say.

*Unciola irrorata* Say, Jour. Acad. Nat. Sci. Philadelphia, i, p. 389, 1818.

Milne-Edwards, Hist. nat. Crust., iii, p. 69, 1840 (= Say).

Stimpson, Marine Invertebrata of Grand Manan, p. 45, 1853.

*Unciola irrorata* Say—(continued).

- Bate, Catalogue Amphip. Crust. British Mus., p. 279, 1862 (description compiled from Say).  
 Verrill, Inverteb. Animals Vineyard Sound, Report U. S. Comm. Fish and Fisheries, part i, p. 340 (46), 1874.  
 Smith, in Verrill, op. cit., p. 567 (273), pl. 4, fig. 19, 1874.  
*Glaucnomet leucopis* Kröyer, Naturh. Tidsskrift, II, i, p. 491, pl. 7, fig. 2, 1845; in Gaimard, Voyage en Scandinavie, Crust., pl. 19, fig. 1. 1849.  
 Goes, Öfversigt Vetenskaps-Akad. Förhandlingar, Stockholm, 1865, p. 533.  
 Boeck, Christiania Videnskabs-Selskabs Forhandlingar, 1870, p. 259 (179); Scandinaviske og arktiske Amphip., p. 636, 1876.  
 G. O. Sars, Archiv Mathem. Naturvid., Kristiania, ii, p. 360, 1876.  
 Norman, Proc. Royal Soc. London, xxv, p. 208, 1876.  
*Unciola leucopis* [-is] Bate, Catalogue Amphip. Crust. British Mus., p. 279, pl. 47, fig. 3, 1862 (description and fig. after Kröyer).  
 "Cyrthopium Darwini Danielssen, Beretning om en Zoologisk Reise, p. 8," (Boeck.)

This is one of the most abundant of all New England Amphipoda, being found in greater or less abundance in a very large proportion of the dredgings from the shallowest water down, at least, to 400 fathoms, and from all kinds of bottom, though in less abundance in mud than among sand and shells. I have collected it at Great Egg Harbor, New Jersey, where Say's original specimens were obtained, and at various points along the New England coast from Connecticut to the Bay of Fundy. It was dredged by Mr. Harger and myself while on board the Bache in 1872, on St. George's Banks, and in 430 fathoms east of these Banks, north latitude  $41^{\circ} 25'$ , west longitude  $65^{\circ}, 42'3'$ . It was obtained in abundance in and off Halifax Harbor, Nova Scotia, by the U. S. Fish Commission, in 1877; and I have examined specimens dredged in the Gulf of St. Lawrence by Mr. Whiteaves, and on the coast of Labrador by Prof. Packard. Kröyer's specimens of *Glaucnomet leucopis* were from Greenland, and Norman reports it, under the same name, as taken in 100 fathoms in Davis Strait by the Valorous Expedition. Boeck records the same species from Spitzbergen and Norway, and G. O. Sars reports numerous specimens, obtained by the Norwegian Expedition in 1876, from 412, 417, and 520 fathoms, in the area of cold water off the west coast of Norway.

In life, the body of the animal above is usually bright red more or less mottled, especially upon the sides, with white; the outer surfaces of the larger gnathopods are broadly marked with bright red, and the antennulæ and antennæ are annulated with the same color. In some individuals, especially from muddy bottoms, the red is nearly all wanting; in others the red appears, to the naked eye, to

be uniformly diffused, giving the animal a pale red tint; in still others the red is largely replaced by brown. The animal apparently does not construct tubes for itself, though often found in the tubes of other Amphipoda and in the tubes of Annelida. In the Bay of Fundy I have found it abundantly in small holes in sandy mud near low-water mark.

The species described by Say and that described by Kröyer are not only congeneric, as suggested by Dana, but apparently specifically identical. Specimens from the coast of New England agree in every particular with Boeck's descriptions and with Kröyer's descriptions and figures, except in the details referred to beyond. Say describes the second gnathopods as "adactyle" and the third pair of uropods as simple, depressed and concealed by the others, and he failed to distinguish the very short sixth segment of the pleon from the telson, describing the two together as the terminal segment of the "tail." These are very natural errors, considering the minuteness of the appendages. In all other respects Say's description is correct. Kröyer, on the other hand, incorrectly describes and figures the third uropods as bi-ramus, mistaking the terminal lobe on the inner side of the base for a second ramus. Boeck, who had access to Kröyer's types, states that Kröyer's figure of the third uropod is incorrect but does not mention the corresponding error in the description of the species. White (Catalogue Crust. British Museum, p. 90, 1847) records, as in the British Museum, specimens of *Unciola irrorata* received from Say; Bate, however, (Catalogue Amphip. Crust. British Museum, p. 279, 1862) states that he has seen no specimens, but refers Kröyer's species to *Unciola*, although he in part misquotes and in part misunderstands Say's generic description. Bate appears to have drawn his description of Kröyer's species from the original figure and generic diagnosis and not from the very full description of the species, for he says that no reference to the telson is made either by Say or by Kröyer and that it is not impossible that the genus is synonymous with "*Microdendotopus*," although the telson is described by Kröyer, in the description just referred to, and is figured in the Voyage en Scandinavie.

#### *The genus Lepidactylis.*

It has long been known to me that Say's genus *Lepidactylis* was congeneric with *Sulcator* of Bate, as suggested by Dana in 1852; but Bate's description and figures not appearing fully to warrant the assumption of the identity of the European and American species,

and not at the time having access to the figures of Slabber's *Oniscus arenarius*, upon which Latreille's genus *Pterygocera* was based, I, in 1874, recorded, in the Report on the Invertebrate Animals of Vineyard Sound, Say's species under his generic and specific names and made no attempt to straighten the generic or specific synonymy. A richly illustrated memoir, by Carl Bovallius, on the European *Sulcator* (*Pterygocera*), and British specimens received from the Rev. A. M. Norman, have recently afforded an opportunity for comparing the American and European forms. On comparing New England specimens of Say's species with Bovallius' numerous and excellent figures, and with the British specimens, I can find no characters by which the American can be distinguished from the European form. Say's generic name should therefore be retained in place of Latreille's *Pterygocera*, though Slabber's specific name (fortunately a more appropriate designation) takes precedence of Say's *dytiscus*. The following synonymy of the genus and species sufficiently explains these changes in nomenclature. Except under *Lepidactylis*, I give only the earliest reference under each name, as this part of the synonymy is pretty fully given by Bovallius.

# PTERYGOCERINÆ Bovallius.

## Lepidactylis Say.

*Oniscus* Slabber, *Natuurkundige Verlustigingen*, p. 92, pl. 11, figs. 3, 4, 1778.

*Lepidactylis* Say, *Jour. Acad. Nat. Sci. Philadelphia*, i, p. 379, 1818 (*dytiscus* the only species).

Desmarest, *Dictionnaire Sci. nat.*, xxviii, p. 358, 1823 (=Say); *Consid. génér. Crust.*, p. 272, 1825 (=Say).

M.-Edwards, *Ann. Sci. nat.*, Paris, xx, p. 397, 1830 (=Say).

Dana, *Amer. Jour. Sci.*, II, viii, p. 138, 1849, and xiv, p. 313, 1852 (>*Bellu* Bate); *U. S. Expl. Exped.*, *Crust.* p. 912, 1853.

Bate, *Catalogue Amphip. Crust. British Museum*, p. 111, 1862 (=Say).

*Pterygocera* Latreille, *Encyclopédie méthodique*, x, pp. 121, 236, 1825 (teste Bovallius); in Cuvier, *Règne animal*, 2<sup>e</sup> édit., iv, p. 124, 1829.

*Bellu* Bate, *Ann. Mag. Nat. Hist.*, II, vii, p. 318, 1851.

*Sulcator* Bate, *Ann. Mag. Nat. Hist.*, II, xlii, p. 504, 1854 (in place of *Bellu* preoccupied).

According to Bovallius, Statius Müller, in a German translation of Slabber's work above referred to, in 1781 proposed the generic name *Haustorius* for Slabber's species; but, as Bovallius says, the name is an adjective, has never come into use, and is properly rejected.



**Lepidactylis arenarius.**

*Oniscus arenatus* Slabber, op. cit., 1778 (corrected to *arenarius* in errata).

*Lepidactylis dytiscus* Say, loc. cit., p. 380, 1818.

Bate, Catalogue Amphip. Crust. British Museum, p. 112, 1862 (=Say).

Smith, Inverteb. Animals Vineyard Sound. Report U. S. Comm. Fish and Fisheries, part i. p. 556 (262), 1874.

*Pterygocera arenaria* Latreille. Encyclopédie méthodique, 1825 (based on Slabber's species; teste Bovallius).

Bovallius. Notes on *Pterygocera arenaria* Slabber (Bihang till Svenska Vetenskaps-Akad. Handlingar iv, no. 8). pp. 1-27. pls. 1-4, 1875.

*Bellin arenaria* Bate, Ann. Mag. Nat. Hist., II, vii, p. 318, pl. 9, figs. 1-8, 1851 (gen. et sp. nov.)

*Sulcator arenarius* Bate, Ann. Mag. Nat. Hist., II, xiii, p. 504, 1854.

*Sulcator arenatus* Boeck. Christiania Videnskabs-Selskabs Forhandlinger, 1870, p. 137 (57).

Coast of Georgia (Say). New Haven!, Connecticut, sandy shores, at low water, not rare, and also dredged in shallow water (A. E. Verrill, S. I. Smith, et al.) Vineyard Sound!, 5 to 10 fathoms, sandy and shelly bottoms, 1871, 1875. Smith's Point!, Beverly, Massachusetts, sand, at low water, August 25, 1878 (J. H. Emerton). These specimens collected by Mr. Emerton are the only ones I have seen from north of Cape Cod. On the European coast, it is reported from the British Isles! (Norman, Bate), the coast of Holland (Slabber), and Scandinavia (Boeck, Bovallius).

**EXPLANATION OF PLATE IIa***Cerapus tubularis.*

All the figures are enlarged seventy diameters, except 4, *b*, which is enlarged one hundred and forty diameters.

FIGURE 1.—First gnathopod and epimeron of the right side of an adult male

FIGURE 2.—Second gnathopod and epimeron of the right side of the same specimen

FIGURE 3.—First pereopod and epimeron of the right side of the same specimen.

FIGURE 4.—*a*, Third pereopod and epimeron of the right side of the same specimen; *b*, distal portion of the same still more enlarged.

FIGURE 5.—Pleopods of the right side of an adult female: *a*, first; *b*, second; *c*, third.

FIGURE 6.—Extremity of the pleon of the same specimen, dorsal view, showing uropods and telson.

NEW HAVEN, July 1, 1880.

## VIII.—NEW ENGLAND ANNELIDA.

### PART I.—HISTORICAL SKETCH, WITH ANNOTED LISTS OF THE SPECIES HITHERTO RECORDED. By A. E. VERRILL.

Previous to the last ten years very little had been published in this country concerning the marine annelids of our coast, and very few of our species had been recorded, either by foreign or American writers.

A large proportion of the New England species are now known to be identical with those of Northern Europe, therefore descriptions of such species are to be found in nearly all foreign works relating to the European annelids, from the days of Linné down to the present time.

It is not my intention to enumerate, at this time, all the European works which must be consulted by a student of our annelids, for such a list would be nearly coëxtensive with the entire literature of the Annelida. Among the more important of the European works, containing descriptions and figures of many of our Annelids, are those of O. Fabricius;<sup>1</sup> Ærsted;<sup>2</sup> M. Sars;<sup>3</sup> Grube;<sup>4</sup> Malmgren;<sup>5</sup> Quatrefages;<sup>6</sup> Ehlers;<sup>7</sup> G. O. Sars;<sup>8</sup> Malm;<sup>9</sup> Theel.<sup>10</sup>

<sup>1</sup> OTHO FABRICIUS, *Fauna Groenlandica*, pp. 279–315. Hafniæ et Lipsiæ, 1780.

The Latin descriptions in this work are given with considerable detail, and are, in all respects, much better than most of those published in the last century, or even much later. Many of his species are common on the New England coast.

<sup>2</sup> A. S. ÆRSTED, *Grönlands Annulata Dorsibranchiata* [eight plates]. Kjøbenhavn, 1843.

*Annulatorum Danicorum Conspectus*, Fasc. I, *Maricolæ* [plates]. Hafniæ, 1843.

<sup>3</sup> M. SARS, *Fauna Littoralis Norvegiæ*, i, 1846; ii, 1856.

Beretning om en i Sommeren 1849 foretagen Zoologisk Reise i Lofoten og Finmarken [pp. 1–91; annelids, pp. 76–91]. <Nyt. Magaz. Naturvid., vi, 1850.

Bidrag til Kundskaben om Norges Annelider, fjerde afhandling. <Vidensk. Forhandl. Christiania, 1861.

Geologiske og Zoologiske Jagttagelser autillede paa en Reise i en Deel af Trondhjems i Sommeren 1862. 1863.

Also various other papers in the publications of learned societies, 1847–1864.

<sup>4</sup> ADOLPH EDUARD GRUBE, *Die Familien der Anneliden*, pp. 163. Berlin, 1851.

*Annulata Semperiana*, Beiträge zur Kenntniss der Anneliden Fauna der Philippinen, 4to, pp. 300, pl. 15. = Mémoires de L'académie Impériale des Sciences de St. Petersburg, VII, vol. xxv, No. 8, 1878.

Of these, only Ehlers and Quatrefages have actually described or mentioned specimens from the New England Coast.

Of the southern species, which extend northward to the New England coast, some were described by Bosc and other early writers.

The important works of Audouin and Milne-Edwards;<sup>11</sup> of Claparède;<sup>12</sup> of Kinberg,<sup>13</sup> and others, although containing but few of our species, are intimately connected with the history of our anne-

Also many papers in the Archiv für Naturgeschichte; Müller's Archives; Proceedings of the Vienna Academy, 1866-1877; and in the publications of other learned societies.

<sup>5</sup> A. J. MALMGREN, Nordiska Hafs-Annulata. <Ofvers. K. Vet.-Akad. Förh., pp. 51-110, pl. 8-15; pp. 355-410, pl. 18-29. 1865.

Annulater Polychæta Spetsbergiæ, Grœlandiæ, Islandiæ et Scandinaviæ hactenus cognita, pp. 1-127, pl. 1-14. Helsingfors, 1867.

<sup>6</sup> A. DE QUATREFAGES, Histoire naturelle des Annelés marins et d'eau douce, vols. i, ii, with atlas. Paris, 1865. [Published in the autumn of 1866. t. Mg'n].

<sup>7</sup> ERNST EHLERS, Die Borstenwurm (Annelida Chætopoda), 4to, pp. 748, 24 plates. Leipzig, 1864-8.

<sup>8</sup> G. O. SÆRS, Diagnoser af nye Annelider fra Christianiafjorden. <Vidensk.-Selsk. Forhandl. Christiania, 1871.

Bidrag til Kundskaben om Dyrelivet paa vore Havbanker. <The same. 1872.

Also other papers in the same serial, and elsewhere.

<sup>9</sup> A. W. MALM, Annulater i hafvet utmed Sverges westkust och omkring Göteborg. <Göteborgs Kongl. Vetensk. Vitt. Samh. Handlingar, xiv [pp. 69-105, pl. 1]. 1874.

<sup>10</sup> H. J. THÉEL, Les Annélides Polychètes des mers de la Nouvelle-Zemble, 4to, pp. 75, pl. 1-4. <Kongl. Svenska Vet.-Akad. Handlingar, xvi. Stockholm, 1879.

Études sur les Géphyriens inermes des Mers de la Scandinavie, du Spitzberg et du Groenland [pp. 1-27, pl. 1-4] <K. Svenska Vet. Akad. Handl., iii, No. 6, 1875.

<sup>11</sup> AUDOUIN AND H. MILNE-EDWARDS, Recherches pour servir à l'Histoire naturelle du littoral de la France, vol. ii; Annelides [by Milne-Edwards]=Classification des Annélides et Description de celles qui habitent les côtes de la France. <Annales des Sciences naturelles, xxvii [pp. 337-447, pl. 7-15], 1832; xxviii [pp. 187-247, pl. 9, 10], 1833; xxix [pp. 195-269, 388-412, pl. 13-18], 1833; xxx [pp. 411-425, pl. 22], 1833.

<sup>12</sup> ÉDOUARD CLAPARÈDE, Études anatomiques sur les Annélides, Turbellariés, Opalines et Grégairines observées dans les Hébrides. <Mem. de la Soc. de Phys., et d'Hist. nat. de Genève, vol. xvi, 1861.

Glanures Zootomiques parmi les Annélides de Port-Vendres (Pyrénées Orientales). <Mémoires de la Société de Physique et d'Hist. nat. de Genève, vol. xvii [4to, pp. 463-600, pl. 1-8], 1864.

Les Annelides Chætopodes du golfe de Naples. Genève, 1868, 1 vol., in 4to. <The same, vol. xix, xx, Genève, 1868. 1869.

Supplément aux Annélides Chætopodes, etc. Genève, 1870, in 4°. <The same, vol. xx [pp. 365-542, pl. 1-14], 1870.

Recherches sur la Structure des Annélides Sédentaires. = The same, vol. xxii [pp. 200, pl. 1-15], Genève, 1873.

lids, for in them many of our genera were established, and numerous species from southern Europe, closely allied to our own, were described and illustrated in great detail.

The following lists are arranged, as nearly as possible, in chronological order. Species when recorded for the first time, as from the northeastern coast of America, are printed in italics, unless indeterminate by me. The names placed in the last column as the equivalents of the original names, are those used by the writer in the Check-list of Marine Intervebrates,<sup>14</sup> edition of 1879, unless otherwise indicated. Those names that have been since changed are enclosed in brackets.

Although a considerable number of changes in the nomenclature of the annelids, included in the first edition of the Check-list, have become necessary or desirable, and may be adopted in the second, or systematic part of the present paper, I have thought it best to introduce only some of the more important ones, or those that relate to the more common species, in the following lists, the Check-list being still kept, as a convenient standard of reference, for the various synonymous names that have formerly been used for those species included in it.

The principal changes which I have here introduced in the synonymical lists are as follows :

*Oistenides* to be changed to *Pectinaria* ; *Anthostomu* to *Scoloplos* ; *Rhynchobolus dibranchiatus* to become the type of the new genus *Euglycera*, herein established (see p. 295).

The common *Phascolosoma cæmentarium* appears to be identical with *P. strombi* (*Phascolion strombi* Theel) of Europe.

The earliest notices of any of our annelids are to be found in the conchological works of Gould and others, but such species as were mentioned by them are mostly those that form more or less solid tubes, and as their notes and descriptions usually refer only to these tubes, it is seldom possible to identify, with any certainty, the species mentioned by them.

For greater convenience, I have also included, in the lists, the small number of Gephyreans that have been recorded from our coasts. The leeches are omitted.

<sup>13</sup> J. G. H. KINBERG, *Annulata Nova*. <Stockholm, Akad. Ofversigt, xxi, 1865, pp. 559-574; xxii, 1866, pp. 167-179, 239-258; xxiii, 1867, pp. 97-103, 337-357.

Kongliga Svenska Fregatten *Eugenies* Resa, omkring jorden, Zoology, I, [4to, pp. 1-32, pl. 1-8]. <Kong. Svenska Vetenskaps-Akad. Stockholm, 1867.

<sup>14</sup> A. E. VERRILL, Preliminary Check-list of the Marine Invertebrata of the Atlantic Coast, from Cape Cod to the Gulf of St. Lawrence. Author's edition, New Haven, June, 1879.

1842.—AUGUSTUS GOULD. *Report on the Invertebrata of Massachusetts [first edition].* Boston, 1841.

Certain tube-making species are recorded (pp. 7–11), with descriptive notes. A few other species are mentioned by name (p. 343).

*List of Species.*

<i>Pectinaria Belgica</i> , p. 7, fig. 1.	= [ <i>Pectinaria Gouldii</i> V.]
Amphitrite ventilabrum, p. 7.	= <i>Sabella</i> , several species, undeterminable.
<i>Spirorbis nautiloides</i> , p. 8, fig. 3.	
<i>Spirorbis spirillum</i> , p. 8.	= <i>Spirorbis borealis</i> Daud.
<i>Spirorbis sinistrorsa</i> , p. 9, fig. 4.	= <i>Spirorbis lucidus</i> .
<i>Serpula vermicularis</i> , p. 10.	= ? <i>Hydroides dianthus</i> V.
<i>Aphrodita aculeata</i> , p. 343.	= <i>Aphrodite aculeata</i> L.
<i>Polynoë squamata</i> , p. 343.	= <i>Lepidonotus squamatus</i> .
<i>Nereis margaritacea</i> , p. 343.	= ? <i>Nereis pelagica</i> .
<i>Phyllodoce viridis</i> Johnst., p. 343.	Undeterminable.
<i>Phyllodoce lamelligera</i> Johnst., p. 343.	Undeterminable.

The last five are accompanied neither by descriptions nor by notes on habits, and cannot be determined, except conjecturally, but there can be little doubt as to the identity of the first three of these.

1852.—L. F. DE POURTALES. *On the Gephyrea of the Atlantic Coast of the United States.* < *Proc. Amer. Assoc. Adv. Science*, for 1851, [vol. v, pp. 39–42]. 1852.

*Echiurus chrysacanthophorus* (Couth.) P., p. 39.  
*Sipunculus Gouldii*, sp. nov., p. 40. = *Phascolosoma Gouldii*.  
*Phascolosoma Bernhardus*, p. 41. = [*Phascolion strombi* (Mont.) Theel.] = *Phascolosoma cæmentarium* Quatr.\*

1853.—WM. STIMPSON. *Synopsis of the Marine Invertebrata of Grand Manan* [pp. 29–36]. < *Smithsonian Contributions to Knowledge*, vol. vi. Washington, 1853.

In this work, Dr. Stimpson published a list of the species collected by him in the Bay of Fundy. His list, though exceedingly incom-

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\* This common and very generally distributed species is, without much doubt, identical with the common shell-inhabiting species of northern Europe—the *Phascolion Strombi* Theel. This species has had a large number of specific names, under three genera. It is the *Strombi* Mont., *dentalii* Gray, *bernhardus* Forbes, *granulatum* Leuck., *capitatus* Rathke, *concharum* Cerst., *cæmentarium* Quatr., *hamulatum* Packard. Perhaps the *Phascolosoma tubicola*, described by me, is only a variety of the same species.

plete, added many species and contained all that was known, for many years afterwards, concerning the annelids of that prolific region. The species enumerated by him are included in the following list. In the identification of many of the following species I had, formerly, the personal assistance of Dr. Stimpson; in company with him, I also dredged many of the species in the same region, in 1861.\*

*List of Species.*

Sipunculus Bernhardus, p. 28.	= [Phascolion strombi Theel.]
Sternaspis fossor, sp. nov., p. 29.	
Spirorbis spirillum Lam., p. 29.	= Spirorbis borealis.
Spirorbis nautiloides Lam., p. 29.	= Spirorbis Stimpsoni Ver.
Spirorbis vitrea (Fabr.) St., p. 29.	= Spirorbis vitreus.
Spirorbis porrecta (Fabr.), p. 29.	= Spirorbis lucidus Mörch.
Spirorbis quadrangularis, sp. nov., p. 29.	
Spirorbis granulata (Müll.), p. 29.	? = Spirorbis cancellatus.
Vermilia serrula St., sp. nov., p. 29.	
Protula media St., sp. nov., p. 30.	
Sabella pavonina Sav., p. 30.	? = Sabella pavonia Mgn.
Sabella zonalis St., p. 30.	? = Sabella neglecta.
Pectinaria Grœnlandica(?) Grube, p. 30.	= [Pectinaria granulata.]
Lumara flava St., g. et sp. nov., p. 31.	= Thelepus cincinnatus.
Terebella brunnea St., sp. nov., p. 31.	= Amphitrite brunnea.
Terebella cirrata Cuv., p. 31.	= Amphitrite cirrata.
Olymene lumbricalis (Fabr.) Sars, p. 31.	= Nicomache lumbricalis.
Arenicola piscatorum Cuv., p. 31.	= Arenicola marina.
Siphonostomum asperum, sp. nov., p. 31.	= Trophonias aspera V.
Tecturella flaccida St., gen. et sp. nov., p. 32, fig. 21.	= Flabelligera affinis Sars.
Brada granosa St., gen. et sp. nov., p. 32.	
Brada sublaevis St., gen. et sp. nov., p. 32.	
Ophelia glabra St., sp. nov., p. 33.	= Ophelia limacina Rathke.
Aricia quadricuspis(?) Grube, p. 33.	= [Naineis quadricuspida.]
Glycera capitata Cœsted, p. 33.	= Rhynchobolus capitatus.
Glycera viridescens St., sp. nov., p. 33.	= Goniada maculata.
Phyllodoce Grœnlandica Cœs., p. 33.	
Nephtys ciliata Müll., p. 33.	
Nephtys ingens St., sp. nov., p. 33.	? = Nephtys paradoxa
Description insufficient.	Malm.

\* I also dredged, in that vicinity, in 1859, 1864, 1865, 1868, 1870, 1872, but have not published the very numerous additions to the list of annelids.

- Nereis abyssicola* St., sp. nov., p. 33.  
*Nereis iris* St., sp. nov., p. 33.  
*Nereis denticulata*, sp. nov., p. 33, fig. 23. = *Nereis pelagica* Linné.  
*Nereis grandis* St., sp. nov., p. 34, fig. 24. = *Nereis virens* Sars.  
*Enonella bicarinata*, gen. et sp. nov., p. 34. Not seen by me.  
*Eunice Ærstedii* St., sp. nov., p. 34. = *Leodice vivida*, young.  
*Eunice vivida* St., sp. nov., p. 35, fig. 26. = *Leodice vivida* V.  
*Onuphis Eschrichtii*, p. 35. = *Nothria conchylega* Mgn.  
*Cryptonota citrina* St., gen. et sp. nov.,  
     p. 36, fig. 27. = *Spinther citrinus* V.  
*Euphrosyne borealis* Ærs., p. 36.  
*Pholoë tecta* St., sp. nov., p. 36. = *Pholoë minuta*, var.  
*Lepidonote cirrata* Ærs., p. 36. = *Harmothoë imbricata*.  
*Lepidonote punctata* Ærs., p. 36. = *Lepidonotus squamatus*.  
*Lepidonote scabra* Ærs., p. 36. = *Eunoa Ærstedii* Mgn.  
*Aphrodite aculeata* Baster, p. 36.

1855.—JOSEPH LEIDY. *Marine Invertebrate Fauna of the Coasts of Rhode Island and New Jersey*. < *Journal Acad. Nat. Science Philadelphia*, II, vol. iii [pp. 144–148, 4to, two plates; separate copies, pp. 12–16], 1855.

Dr. Leidy, in this work, gave a brief list of Annelids observed by him, and described a number of new and interesting forms.

#### *List of Species.*

- Naraganseta coralii* L., gen. et sp. nov.,  
     p. 144 (12), pl. 11, figs. 46–48. = [*Dodecaceria coralii* V.]  
*Sabella oculifera* L., sp. nov., p. 145 (13),  
     pl. 11, figs. 55–61. = *Potamilla reniformis*.  
*Clymene urceolatus* L., sp. nov., p. 145. Not seen by me.  
*Clymene torquatus* L., sp. nov., p. 146. = *Clymenella torquata* V.  
*Pectinaria auricomma* Grube, p. 146. = [*Pectinaria Gouldii* V.]\*  
*Terebella ornata* L., sp. nov., p. 146, pl.  
     11, figs. 44, 45. = *Amphitrite ornata* V.  
*Spirorbis spirillum* Lam., p. 146. = *Spirorbis borealis*.

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\* Some of the divisions of the genus *Pectinaria*, proposed by Malmgren as genera, do not seem to me well founded; at least, I cannot regard them as of generic value. Among these is the group named *Cistenides*, which does not seem worthy of separation, even as a sub-genus, from *Pectinaria*. The species hitherto named by me *Cistenides Gouldii* should, therefore, be called *Pectinaria Gouldii* V.

- Torquea eximia* L., gen. et sp. nov.,  
p. 146, pl. 11, figs. 51, 52. = *Polycirrus eximius* V.  
*Cirrhatulus fragilis* L., sp. nov., p. 147,  
pl. 11, figs. 39–43. = *Cirrhinereis fragilis* V.  
*Lumbriconereis splendida* Bv., p. 147. = *Arabella opalina* V.  
*Eunice sanguinea* Mont., p. 147. = *Marphysa Leidy* Quatr.  
*Glycera Americana* L., sp. nov., p. 147,  
pl. 11, figs. 49, 50. = *Rhynchobolus Americanus* V.  
*Nereis denticulata* St., p. 148. = *Nereis pelagica* L. and N. *virens*.  
*Siphonostomum affine* L., sp. nov., p. 148. = *Trophonia affinis* V.  
*Lepidonote armadillo* (Bosc) Leidy, p.  
148, pl. 11, fig. 54. = *Lepidonotus squamatus*.  
*Sigalion Mathildæ* (non Aud. and Edw.),  
p. 148, pl. 11, fig. 53. = *Sthenelais picta* V.  
*Ophelia simplex* L., sp. nov., p. 148.  
*Lumbriculus tenuis*, sp. nov., p. 148, pl. 11, fig. 64. Not seen by me.

1860.—ALEXANDER AGASSIZ. *On the Young Stages of a few Annelids.* < *Annals Lyceum Natural History, New York*, vol. viii, [pp. 303–343, pl. 6–11, figs. 1–58], June, 1860.

#### *List of Species.*

- Spirorbis spirillum* Gould (non Pagenst.),  
p. 318, figs. 20–25. = *Spirorbis borealis*.  
*Terebella fulgida* L. Agassiz, MSS., p. 320,  
fig. 19, 19a. Undetermined. Perhaps  
= *Thelepus cincinnatus* or *Lepræa rubra*.  
*Polydora ciliatum* Olap. (?), p. 330, figs. 26–38.  
*Nerine coniocephala* Johnst. (?), p. 333, figs. 39–45. = *Spio*, sp.  
*Phyllodoce maculata* Örsted, p. 333, figs. 46–55.

The last three cannot be positively identified without a reëxamination of the specimens, which are not, at present, accessible to me, for they were sent to Europe, for study, many years ago.

In addition to these, Mr. Agassiz described and figured, in the same paper, some unknown annelid larvæ; one which he supposed to be the larva of a Nemertean (? *Nareda* Girard), and considered the same as “Lovén’s annelid larva,” which, in the light of subsequent observations, is an annelid, probably identical with, or allied to *Polygordius*; and also the larval forms of *Planaria angulata*. The latter is not the *Planaria angulata* of Fabricius, which was a Nemertean, but is a true Planarian (the *Bdelloura candida* Leidy).



- 1862.—ALEXANDER AGASSIZ. *On Alternate Generation in Annelids, and the Embryology of Autolytus cornutus.* <Journal Boston Society of Natural History, Vol. vii, [pp. 392-409, pl. 9-11], July, 1862.

*Autolytus cornutus*, sp. nov., p. 390, pl. 9-11. Massachusetts Bay, Buzzard's Bay.

*Autolytus longosetosus* A. Ag., p. 404, [21], Male=?*A. longisetosus*; female probably=*A. Alexandri* Mgn. Massachusetts Bay.

Mr. Agassiz states that the form that he supposed to be the female of *A. longisetosus* has "no less than ten" anterior segments, without long setæ. Among the numerous specimens of *Autolytus* collected at Salem, Mass., by Mr. J. H. Emerton, there are both males and females of what I consider the true *A. longisetosus* (pl. 12, figs. 10, 10a, 10c, ♂.) These have, in both sexes, six short anterior segments, lacking long dorsal setæ, and bearing only short ventral setæ; the post-buccal segment bears very long dorsal cirri (*dc*), but no setæ.

In the same lots, collected in early spring, there is a very distinct species, which has, in both sexes, fourteen anterior segments, with short ventral setæ only, including the first post-buccal segment, which bears a pair of very large dorsal cirri, and a small cluster of setæ directly beneath them; the second segment is also very much compressed, and its setæ are more or less completely concealed by the large cirri, in a dorsal view (plate 12, figs. 8-8c). These are, perhaps, the *A. Alexandri* Mgn., and they may prove to be the sexual forms of my *Stephanosyllis ornata*. If so, it would confirm the separation of *Stephanosyllis*, as a genus distinct from *Autolytus*.

In the sexual forms that I consider identical with *Autolytus cornutus* A. Ag., I have constantly found six anterior setigerous segments in both sexes (pl. 12, fig. 4, ♂; fig. 6 ♀, ventral views), but in the male the first fascicle is concealed, in a dorsal view, by the large dorsal cirrus of the first post-buccal segment; this first segment bears no setæ, in this and the several allied species, which I consider typical *Autolyti* (pl. 12, figs. 5, 6, 9-9b, 10, 10a), but in this species it has a small papilliform ventral cirrus, not mentioned by Mr. Agassiz. He also failed to notice the ventral tentacular cirrus of the female, though he figures and describes the corresponding cirrus of the male. Although this organ is small, and often seen with difficulty, especially when the body is much compressed, as represented in the figures by Mr. Agassiz, it is quite as large as in the male, and often projects beyond the sides of the head.

Mr. Agassiz stated that in his *A. cornutus* the male had only five anterior setigerous segments, while the female had six. It seems possible, however, that he overlooked the first, very short, compressed segment, with its small fascicle of setæ, which is entirely concealed, in a dorsal view, by the large dorsal cirri of the preceding segment. At least, I have never been able to find a male, of this species, with only five anterior setigerous segments.

1863.—A. S. PACKARD, JR. *A list of Animals dredged near Caribou Island, Southern Labrador, during July and August, 1860.*  
 < *Canadian Naturalist and Geologist*, vol. vii, [pp. 401-429, 2 plates].

The lists of annelids and other invertebrates, in this article, contain many typographical errors, in the names of the species. Throughout the article "feet" was printed, instead of fathoms, for the depths. Some important transpositions also occur in the lists.

#### *List of Species.*

- |                                                   |                               |
|---------------------------------------------------|-------------------------------|
| Pectinaria Eschrichtii, pp. 403, 418.             | = [Pectinaria granulata.]     |
| Onuphis Eschrichtii, p. 403.                      | = Nothria conchylega.         |
| Vermilia serrula, pp. 403, 418.                   |                               |
| Spirorbis cancellata, pp. 403, 418. (cancellatus) |                               |
| Spirorbis vitrea, pp. 403, 417. (vitreus)         |                               |
| Sipunculus, sp. nov., p. 417.                     | = [Phascolion strombi Theel.] |
| Spirorbis spirillum, p. 417.                      | = Spirorbis borealis.         |
| Spirorbis nautiloides, p. 417. -                  | ? = Spirorbis Stimpsoni V.    |
| Spirorbis porrecta, p. 417. (porrectus)           | ? = Spirorbis lucidus.        |
| <i>Spirorbis glomerata</i> , p. 418. (glomeratus) |                               |
| Spirorbis quadrangularis, p. 418.                 |                               |
| Terebella, n. sp., p. 418.                        |                               |
| <i>Siphonostomum plumosum</i> , p. 418.           | = Trophonina plumosa.         |
| Cirrhatulus, n. sp., p. 418.                      | = Cirratulus cirratus.        |
| <i>Nephtys coeca</i> , p. 418.                    | Doubtful.                     |
| Heteroneis arctica, p. 418. (Heteronereis)        | = Nereis, sp.                 |
| Eteone, sp., p. 418.                              |                               |
| Nereis pelagica, p. 418.                          |                               |
| Nereis, n. sp., pp. 418, 424.                     | ? = Nereis pelagica.          |
| Lepidonote cirrata, pp. 418, 424.                 | = Harmothoe imbricata.        |
| Lepidonote punctata, pp. 418, 424.                | = Lepidonotus squamatus.      |

- 1863.—WM. STIMPSON. *Synopsis of the Marine Invertebrata collected by the late Arctic Expedition, under Dr. I. I. Hayes.* < *Proceedings of the Academy of Natural Sciences of Philadelphia*, vol. xv, [pp. 138-142,] May, 1863.

All the annelida recorded are from the western coast of Greenland.

*List of Species.*

Lepidonote cirrata, p. 140.	=Harmothoe imbricata.
Lepidonote punctata, p. 140.	=Lepidonotus squamatus.
Onuphis conchilega, p. 140.	=Nothria conchylega.
Nereis pelagica, p. 140.	
Nephthys cæca, p. 140.	
Phyllodoce Grœnlandica, p. 140.	
Scoloplos quadricuspida, p. 140.	=[Naineis quadricuspida.]
Cirratulus borealis, p. 140.	=Cirratulus cirratus.
Ammotrypane limacina, p. 140.	=Ammotrypane aulogaster.
Siphonostomum plumosum, p. 140.	=Trophonia plumosa.
Tecturella flaccida, p. 140.	=Flabelligera affinis.
Brada inhabilis, p. 140.	
Terebella cincinnata, 141.	=Thelepus cincinnatus.
Terebella cirrata, p. 141.	=Amphitrite cirrata.
Pectinaria Eschrichtii, p. 141.	
Spirorbis nautiloides, p. 141.	
Priapulus caudatus, p. 141.	

- 1866.—A. DE QUATREFAGES. *Histoire Naturelle des Annelés. Paris, 1865 [1866].* (Suites a Buffon).

In this general work, largely compiled, Quatrefages included most of the species mentioned by Stimpson and Leidy, and translated (sometimes erroneously) more or less of their descriptions, with some changes in the names. But the only species from our coast that he seems to have personally examined is the common *Nereis virens* Sars (= *N. grandis* Stimpson), which he redescribed under the name of *Nereis Yankiana* (i, p. 553, pl. 17, figs. 7, 8), and *Phascolosoma cæmentarium*, sp. nov.= [*Phascolion strombi* Theel.]

- 1867.—A. S. PACKARD, JR. *Observations on the Glacial Phenomena of Labrador and Maine, with a view of the recent Invertebrate Fauna of Labrador.* < *Memoirs of the Boston Society of Natural History*, vol. i, [4to, pp. 210-303, pl. 7, 8].

This paper includes the species enumerated by Dr. Packard in his preliminary paper, noticed above, with some additions. Although many of the numerous typographical and other errors of that article were corrected in this later and more complete one, the latter also contains various orthographical errors, even in the names of the species, not only among the annelids but in the lists of species of the other groups. Some of these very obvious errors are indicated in the following list. Many of the species in this list I have personally examined.

*List of Species.*

*Syrinx?*, sp. nov., p. 290., pl. 8, fig. 10. Undeterminable.

*Phascolosoma hamulatum*, sp. nov., pl. 8,

fig. 8, p. 290.

= [Phascolion strombi Theel.]

*Spirobis vitrea*, p. 291. (vitreus)

*Spirorbis sinistrorsa*, p. 292. (sinistrorsus)

*Spirorbis porrecta.* (porrectus)

=*Spirorbis lucidus*.

*Spirorbis cancellata.* (cancellatus)

*Spirorbis granulata.* (granulatus)

*Spirorbis spirillum.*

=*Spirorbis borealis*.

*Vermilia serrula.*

**Amphitrite cirrata.**

Amphitrite? sp.

*Ampharete Grubei.*

*Cistenides granulata*, p. 292. (granulatus)=[*Pectinaria granulata*.]

*Praxilla Mulleri*, p. 293. (Doubtful.) ?=(*Praxillella Mulleri* V.)

**Nicomache lumbricalis.**

**Spiochætopteras typicus. (Spiochætopterus)**

Tubes only. Very doubtful.

**Arenicola piscatorum.**

= *Arenicola marina*.

**Siphonostomum asperum.**

=*Trophonia aspera*.

*Siphonostomum plumosum.*

=*Trophonia plumosa*.

*Cinatululus cirrata.* (Cirratulus)

=*Cirratus cirratus*.

*Heteronereis arctica*? Oers.

=Nereis, sp.

*Nephtys longisetosa.*

Doubtful.

Two species are confounded in the synonymy of this species.

*Nephtys caeca*, p. 294.

Doubtful.

*Eteone cylindrica.*

Doubtful.

*Phyllodice grœnlandica.* (Phyllodoce)

**Onuphis Eschrichtii.**

=*Nothria conchylega*.

*Nereis pelagica.*

Nereis, sp.

?=Nereis pelagica.

*Pholoë minuta.*

Harmothoë imbricata.

Lepidonotus squamatus, p. 295. (squamatus)

The *Pontobdella? livida*, p. 291, pl. 8, fig. 9, is undoubtedly a Nemertean—perhaps a *Cerebratulus* or *Micrura*, but is indeterminable.

1868.—ERNST EHLERS. *Die Borstenwürmer (Annelida Chaetopoda)*, [pp. 1-268, pl. 1-11, publ. 1864; pp. 269-748, pl. 12-24, 1868]. Leipzig, 1864-1868.

Ehlers published in 1868 the second part of his large and elaborate work on Annelida. He had received from the Museum of Comparative Zoology, Cambridge, a collection of New England annelids, and in this part of his book he described, in detail, a number of our common annelids and illustrated several of them. To one of the most common species, his *Glycera dibranchiata*, he devoted thirty-two pages of text and numerous figures, partly anatomical. He described its anatomy with considerable detail. The following are the species particularly mentioned by him as from the New England coast.

*List of Species.*

*Nereis pelagica*, p. 511, pl. 20, figs. 11-20. Labrador to Nahant, Mass.

*Nereis virens*, p. 559-563, pl. 22, figs. 29-32.

*Nereis limbata*, sp. nov., pp. 567-570.

*Nephtys cæca*, p. 588, pl. 23, figs. 10-34. Eastport to Nahant.

*Nephtys buccera*, sp. nov., pp. 617-619, pl. 23, fig. 8. Massachusetts Bay.

*Nephtys discors*, sp. nov., pp. 626-629, pl. 23, figs. 39, 40. Eastport, Me.

*Nephtys ciliata*, p. 629, pl. 23, fig. 36. Edgartown, Mass.

*Nephtys picta*, sp. nov., pp. 632-635, pl. 23, figs. 9, 35. Vineyard Sd. to S. Carolina.

*Glycera capitata*, p. 648. = *Rhynchobolus capitatus* Clap.

*Glycera Americana* Leidy, pp. 668-670, pl. 23, figs. 43-46. = *Rhynchobolus Americanus* V.

*Glycera dibranchiata*, sp. nov., pp. 670-702, pl. 24, figs. 1, 3-8, 10-28. Mass. Bay, New Jersey. = [*Euglycera dibranchiata* V.]\*

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\* This species differs so much from the typical species of *Glycera* and *Rhynchobolus* (whether the latter be distinct or not), that I propose to establish a new genus (*Euglycera*) for it. *Euglycera* may be distinguished by possessing two ligulate branchiæ to each branchiferous parapodial appendage; one of these is connected, at base, with the dorsal side of the parapodia; the other, with the ventral side. Proboscis and jaws are as in *Rhynchobolus*.

- 1871.—A. E. VERRILL. *Marine Fauna of Eastport, Maine.* <  
*Bulletin of the Essex Institute, iii, pp. 2-6, Salem, Mass.,*  
*Jan. 1871.*

*Aphrodite aculeata*, p. 4.  
*Nereis grandis* St., p. 6. = *Nereis virens*.  
*Arenicola piscatorum*, p. 6. = *Arenicola marina*.  
*Myxicola Steenstrupii*, p. 6.  
*Thelphusa* [error typ.] *circinnata* (*Lumara flava* St.), pp. 3, 6.  
= *Thelepus cincinnatus*.  
*Torquea*?, p. 6. = [*Polycirrus phosphoreus* V., 1879.]  
*Eunice*, sp. p. 6. = *Leodice vivida*.  
*Lumbriconereis*, sp., p. 6. = *Lumbrinereis fragilis*.

- 1872-3.—A. E. VERRILL. *Brief Contributions to Zoology from the*  
*Museum of Yale College, No. XXIII.—Results of Recent*  
*Dredging Expeditions on the Coast of New England.*  
[Nos. 1 and 2.] < *American Journal of Science and Arts,*  
*vol. v, [pp. 1-16, January, 1873 (author's ed. issued Dec.*  
*13, 1872); pp. 98-106, February, 1873 (author's ed.,*  
*Jan. 18.)]*

These papers include Annelids dredged in the Bay of Fundy, in 1872, by the party of the U. S. Fish Commission, under the direction of the writer; those dredged at George's Banks and off Nova Scotia, etc., by Messrs. S. I. Smith and O. Harger, on the Coast Survey steamer "Bache," in 1872; and those dredged in the Gulf of Maine, by Messrs. A. S. Packard and C. Cooke, on the same steamer.

#### *List of Species.*

*Hermione hystrix* (?), p. 98. = *Læmatonice armata* V.  
*Antinoë Sarsii*, p. 101. (Sarsi.)  
*Nephtys discors*, p. 103.  
*Nephtys ingens*, p. 103, (? non Stimp.) = *Nephtys incisa* Mgn.  
*Nereis pelagica*, pp. 101, 104.  
*Leodice vivida*, pp. 9, 101, 104.  
*Nothria conchylega*, pp. 9, 102, 104. (conchilega.)  
*Nothria opalina*, sp. nov., pp. 98, 102.  
*Lumbriconereis fragilis*, p. 98. = *Lumbrinereis fragilis*.  
*Goniada maculata*, pp. 98, 103 (descr.)  
*Ammotrypane aulogaster*, p. 101. = *Ammotrypane fimbriata* V.

- Eumenia crassa*, p. 101.  
*Scalibregma inflatum*, p. 98.  
*Trophonia aspera*, p. 98.  
*Sternaspis fossor*, p. 101.  
*Scolecopsis cirrata*, p. 98. = [Scololepis cirrata].  
*Chætozone setosa*, p. 103.  
*Notomastus latericius*, p. 101.  
*Maldane Sarsii*, pp. 99, 103. (Sarsi Mgn.)  
*Nicomache lumbricalis*, p. 101.  
*Praxilla gracilis* Mgn., p. 101. = [Praxillella gracilis V.]\*  
*Praxilla prætermisssa* Mgn., pp. 101, 103. = [Praxillella prætermisssa V.]  
*Praxilla torquata*, p. 101. = Clymenella torquata V.  
*Ampharete Finnarchica*, p. 101.  
*Amphicleis Gunneri*, p. 101.  
*Samytha sexcirrata*, p. 101.  
*Samythella elongata*, gen. et sp. nov., pp. 98, 103.  
*Amage auricula*, p. 98.  
*Melinna cristata*, pp. 98, 103 (descr.)  
*Amphitrite cirrata*, p. 101.  
*Pista cristata*, p. 98.  
*Terebellides Stroemi*, p. 99. (Strömi Sars.)  
*Thelepus cinnatus* (=Lumara flava St.), p. 104.  
*Aphlebina*, sp., p. 101. = [Polycirrus phosphoreus V., 1879.]  
*Phascolosoma borealis*, p. 102, descr. (boreale). = [Phascolosoma eremita Sars.]  
*Phascolosoma cæmentarium*, pp. 99, 102. = [Phascolion strombi.]  
*Phascolosoma tubicola*, sp. nov., pp. 99, 102. = [Phascolion tubicola.]  
*Chætoderma nitidula*, p. 102, (nitidulum).  
 1873.—W. C. M'INTOSH, in *Whiteaves. Report of a Second [1872] Deep-sea Dredging Expedition to the Gulf of St. Lawrence. Montreal, 1873. A report to the Minister of Marine and Fisheries for the Dominion of Canada.*

*List of Species*, p. 14.

- Eunoa nodosa*, 125 fath.  
*Ephesia gracilis*, 125 fath.  
*Nothria conchylega*, 125 fath. [V.  
*Ammotrypane aulogaster*, 100–125 fath. ?= *Ammotrypane fimbriata*

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\* The name, *Praxilla*, Mgn. (1865), having been previously employed for a genus of birds by Reichenbach (1853), I propose to substitute *Praxillella*, for this group.

*Trophonia plumosa*, 100–125 fath.

*Sabella pavonia*, 125 fath.

*Goniada maculata*, 100–112 fath.

*Amphictene auricoma* (tube), 100–112 fath. ?=[*Pectinaria granulata*.]

*Terebellides Strömii*, 100–112 fath. (Strömii Sars.)

*Thelepus circinatus*, 100–112 fath. (cincinnatus) = *T. cincinnatus*.

*Praxilla gracilis*, 100–112 fath. = [*Praxillella gracilis* V.]

*Lumbrineris fragilis*, 200 fath.

*Balanoglossus*, sp.

In the same paper, p. 14, two species of *Gephyrea* are recorded, on the authority of A. E. VERRILL:

*Phascolosoma boreale* Kef. = [*Phascolosoma eremita* Sars.]

*Phascolosoma Ærstedii* Kef. (?) = [*Phascolosoma margaritaceum* Sars.]

1873–4.—A. E. VERRILL. *Report upon the Invertebrate Animals of Vineyard Sound and the Adjacent waters, with an account of the Physical Characters of the Region* [*Crustacea by S. I. Smith and O. Harger*]. < *U. S. Commission of Fish and Fisheries, Part I. Report on the Condition of the Sea Fisheries of the South Coast of New England in 1871 and 1872, by Spencer F. Baird, Commissioner* [pp. 295–747, 38 plates and a map], Washington, 1873. *A separate edition was also published by A. E. Verrill and S. I. Smith, with original pagination on the inner margins, and new pagination on the outer margins, but without the chart.* 1874.

This work included all the species known at that date from the region between Cape Cod and southern New Jersey. Many additional species have subsequently been discovered, especially in the deeper waters, at a greater distance from the coast, and also among the small free-swimming species of Syllidæ.

Extensive dredgings have subsequently been carried on, within these limits, by the U. S. Fish Commission, during the seasons of 1874, 1875, 1880, and 1881. The results of these explorations have not yet been fully reported upon.

In referring to the pages of this report the numbers refer to the original pagination, except those enclosed in brackets, which refer to the author's edition. The first reference, in each case, is to the systematic list of species.

The volume containing this report is dated 1873, when it was printed, but this part of the volume was not actually issued until early in 1874.



*List of Species.*

*Aphrodita aculeata* Linné, pp. 580 [286], 507.

*Lepidonotus squamatus*, pp. 581, [287], 320, 332, 392, 397, 410, 422,  
pl. 10, figs. 40, 41.

*Lepidonotus sublevis* V., sp. nov., pp. 581, [287], 320, 332, 397, 410,  
422, pl. 10, fig. 42.

*Lepidonotus angustus* V., sp. nov., pp. 581, [287], 494.

=*Lepidonotus squamatus*, var.

*Harmothoe imbricata*, pp. 582, [288], 321, 332, 392, 397, 410, 422.

*Sthenelais picta* V., sp. nov., pp. 582, [288], 348, 364, 422, 428, 501.

*Nephtys ingens* Stimp., pp. 583, [289], 431, 434, 507, 521, pl. 12, figs.  
59, 60. =*Nephtys incisa* Mgn.

*Nephtys picta* Ehl., pp. 583, [289], 348, 364, 422, 428, pl. 12, fig. 7.

*Nephtys bucera* Ehl., pp. 583, [289], 416, 422, pl. 12, fig. 58.

*Nephtys ciliata*, pp. 583, [289].

*Eumidia Americana* V., sp. nov., pp. 584, [290], 494. (Eumida.)

*Eumidia vivida* V., sp. nov., pp. 584, [290]. (Eumida.)

*Eumidia papillosa* V., sp. nov., pp. 584, [290]. (Eumida.)

*Eulalia pistacia* V., sp. nov., pp. 584, [290].

*Eulalia granulosa* V., sp. nov., pp. 585, [291].

*Eulalia annulata* V., sp. nov., pp. 585, [291].

*Eulalia gracilis* V., sp. nov., pp. 586, [292].

*Phyllodoce gracilis* V., sp. nov., pp. 586, [292], 494.

*Phyllodoce catenula* V., sp. nov., pp. 587, [293], 494.

*Eteone robusta* V., sp. nov., pp. 588, [294], 746.

*Eteone limicola* V., sp. nov., pp. 588, [294].

*Eteone setosa* V., sp. nov., pp. 588, [294].

*Eteone*, sp., pp. 589, [295].

*Podarke obscura* V., sp. nov., pp. 589, [295], 319, 332, 382, 392, 410,  
440, 453, pl. 12, fig. 61.

*Autolytus cornutus*, pp. 590, [296], 392, 397, 410, 422, 440, 452, 494,  
pl. 13, figs. 65, 66.

*Autolytus*, sp., pp. 590, [296], 398.

=*Proceræa ornata* V.

*Autolytus*, sp., pp. 590, [296].

*Proceræa ornata* V., sp. nov., pp. 746, [452].

*Syllis*, sp., p. 590, [296].

=*Syllis pallida* V., 1875.

*Gattiola*, sp., pp. 590, [296], 453.

*Nereis virens*, pp. 590, [296], 317, 341, 367, 371, 377, 440, 453, 455,  
463, 468, 487, 514, 519, pl. 11, figs. 47-50.

*Nereis limbata*, pp. 590, [296], 318, 341, 371, 377, 382, 392, 422, 440,  
453, 463, 516, pl. 11, fig. 51.

- Nereis pelagica*, pp. 591, [297], 319, 397, 410, 422, 428, 434, 453, pl. 11, figs. 52-55.
- Nereis fucata* Aud. and Edw., pp. 591, [297], 494.
- Nereis*, sp., p. 591, [297].
- Nectonereis megalops*, gen. et sp. nov., pp. 592, [298], 440, 453, pl. 12, figs. 62, 63. = [*Nereis megalops* V., 1879.]
- Diopatra cuprea*, pp. 593, [299], 346, 364, 371, 377, 422, 431, 434, pl. 13, figs. 67, 68.
- Marphysa Leidy*, pp. 593, [299], 319, 332, 347, 364, 410, 422, 434, 517, pl. 12, fig. 64.
- Lycidice Americana*, sp. nov., pp. 593, [299], 508.
- Lumbriconereis fragilis*, pp. 594, [300], 501, 507. (*Lumbrinereis*).
- Lumbriconereis opalina*, sp. nov., pp. 594, [300], 320, 352, 342, 364, 371, 377, 397, 410, 422, 428, 434, 468, pl. 13, figs. 69, 70.  
= *Arabella opalina* V.
- Lumbriconereis tenuis*, sp. nov. pp. 594, [300], 320, 332, 342, 364, 371, 377, 422, 463, (*Lumbrinereis*).
- Ninoë nigripes*, sp. nov., pp. 595, [301], 508.
- Staurocephalus pallidus*, sp. nov., pp. 595, [301], 348, 364.
- Rhynchobolus Americanus*, pp. 596, [302], 332, 342, 364, 371, 377, 428, 434, 453, 453, pl. 10, figs. 45, 46.
- Rhynchobolus dibranchiatus*, pp. 596, [302], 332, 341, 364, 371, 377, 428, 431, 434, 463, pl. 10, figs. 43, 44. = [*Euglycera dibranchiata* V.]
- Eone gracilis*, sp. nov., pp. 596, [302]. = [*Goniada gracilis* V., 1879.]
- Aricia ornata*, sp. nov., pp. 596, [302], 344, 365.
- Anthostoma robustum*, sp. nov., pp. 597, [303], 343, 348, 365, 428, pl. 14, fig. 76.  
= [*Scoloplos robustus* V.]
- Anthostoma fragile*, sp. nov., pp. 598, [304], 344, 365.  
= [*Scoloplos fragilis* V.]
- Anthostoma acutum*, sp. nov., pp. 599, [305], 416, 422, 428, 501, 508.  
= [*Scoloplos acutus* V.]
- Nerine agilis*, sp. nov., pp. 600, [306], 346, 365, 490.
- Scolecoplepis viridis*, sp. nov., pp. 600, [306], 345, 364, 453, 463 (*Scolecoplepis*).
- Scolecoplepis tenuis*, sp. nov., pp. 601, [307], 345, 364 (*Scolecoplepis*).
- Scolecoplepis cingrata*, pp. 602, [308], 416, 422, 428, 501, 507 (*Scolecoplepis*).
- Spio setosa*, sp. nov., pp. 602, [308], 344, 365, 453, pl. 14, fig. 77.
- Spio robusta*, sp. nov., pp. 603, [309], 345, 365.
- Polydora ciliatum*?, pp. 603, [309], 345, 364, 453, pl. 16, fig. 78.  
= [*Polydora littorea* V., sp. nov., (pl. 18, fig. 10).]
- Ophelia simplex*, pp. 603, [309], 319, 332, 410.

- Travisia carnea*, sp. nov., pp. 604, [310], 431, 434, 508.  
*Ammotrypane fimbriata*, sp. nov., pp. 604, [310], 508, pl. 15, fig. 79.  
*Scalibregma brevicauda*, sp. nov., pp. 605, [311], 416, 422.  
*Trophonia affinis*, pp. 605, [311], 432, 434, 507, pl. 14, fig. 75.  
*Brada setosa*, sp. nov., pp. 606, [312], 431, 434, 508.  
*Sternaspis fossor*, pp. 606, [312], 507, pl. 14, fig. 74.  
*Cirratulus grandis*, sp. nov., pp. 606, [312], 319, 332, 348, 364, 371, 377, 422, 468, pl. 15, figs. 80, 81.  
*Cirratulus tenuis*, sp. nov., pp. 607, [313], 416, 422.  
*Cirrhinereis fragilis*, pp. 607, [313], 332, 397, 410, 422.  
*Naraganseta coralii*, pp. 607, [313], 397, 410, 422, 494.  
 = [Dodecaceria coralii V.]  
*Olymenella torquata*, gen. nov., pp. 608, [314], 343, 365, 422, 428, pl. 14, figs. 71-73.  
*Nicomache dispar*, sp. nov., pp. 608, [314], 508.  
*Maldane elongata*, sp. nov., pp. 609, [315], 343, 365, 371, 377.  
*Rhodine attenuata*, sp. nov., pp. 609, [315], 508.  
*Notomastus luridus*, sp. nov., pp. 610, [316], 342, 365, 371, 377.  
*Notomastus filiformis*, sp. nov., pp. 611, [317], 342, 365, 371, 377.  
*Sabellaria vulgaris*, sp. nov., pp. 611, [317], 321, 332, 349, 365, 392, 397, 410, 422, 428, 426, 476, pl. 17, figs. 88, 88a.  
*Cistenides Gouldii*, sp. nov., pp. 612, [318], 323, 332, 349, 365, 371, 377, 422, 428, 434, pl. 17, figs. 87, 87a. = [Pectinaria Gouldii V.]  
*Ampharete gracilis*, pp. 612, [318], 508, pl. 16, fig. 83.  
*Ampharete setosa*, sp. nov., pp. 612, [318], 416, 422, 432, 434.  
*Amage pusilla*, sp. nov., pp. 613, [319].  
*Meliuna cristata*, pp. 613, [319], 432, 434, 507.  
*Terebellides Ströemi*, pp. 613, [319], 507. (Strömi Sars.)  
*Amphitrite ornata*, pp. 613, [319], 320, 321, 332, 348, 365, 377, 382, 422, 428, 453, pl. 16, fig. 82.  
*Nicola simplex*, sp. nov., pp. 613, [319], 321, 332, 382, 392, 397, 410, 422, 453, 494.  
*Scionopsis palmata*, gen. et sp. nov., pp. 614, [320], 321, 332, 397, 410, 476.  
*Lepraea rubra*, sp. nov., pp. 615, [321], 382, 392, 453.  
*Polycirrus eximius*, pp. 616, [322], 320, 332, 371, 377, 382, 392, 410, 422, 434, 453, 468, pl. 16, fig. 85.  
*Chaetobranchus sanguineus*, gen. et sp. nov., pp. 616, [322], 320, 332, 371, 377, 434, 468. = *Enoplobranchus sanguineus* V.  
*Potamilla oculifera*, pp. 617, [323], 322, 332, 382, 392, 397, 410, 422, 476, pl. 17, fig. 86. = *Potamilla reniformis*.

*Sabella microphthalmia*, sp. nov., pp. 618, [324], 323, 332, 392, 397, 410, 422.

*Euchone elegans*, sp. nov., pp. 618, [324], 432, 434, 508, pl. 16, fig. 84.

*Fabricia Leidyi*, sp. nov., pp. 619, [325], 323, 332, 397, 410, 422.

=*Fabricia stellaris* Bv.

*Serpula dianthus*, sp. nov., pp. 620, [326], 322, 332, 392, 397, 410, 416, 422, 426, 428, 476.

=*Hydroides dianthus* V.

*Serpula dianthus*, var. *citrina*, pp. 620, [326].

=*Hydroides dianthus* V., var.

*Spirorbis borealis*, pp. 621, [327].

*Spirorbis lucidus*, pp. 622, [328].

*Clitellio irrorata*, sp. nov., pp. 623, [328], 324, 332, 365, 463.

*Lumbriculus tenuis* Leidy, pp. 623, [329]. Not seen by me.

*Halodrilus littoralis*, sp. nov., pp. 623, [329], 324, 332, 338, 365, 463.

*Enchytræus triventralopectinatus* Minor, pp. 624, [330]. Not seen by me. Doubtful.

1873-4.—A. E. VERRILL. *Brief Contributions to Zoölogy from the Museum of Yale College. Nos. XXV—XXIX. Results of recent Dredging Expeditions on the Coast of New England. Nos. 3—7. From the American Journal of Science and Arts, vol. vi, Dec., 1873 to vol. vii, May, 1874. [Five plates.]*

These papers contain accounts of the dredgings in 1873, in Casco Bay, Maine, and the adjacent waters, by the U. S. Fish Commission, and in the deeper parts of the Gulf of Maine, by the party on the "Bache."

#### *List of Species.*

*Cryptonota citrina*, p. 502. =*Spinther citrinus* V.

*Euphrosyne borealis*, pp. 41, 502.

*Aphrodita aculeata*, pp. 439, 45, 411.

*Lætmonice filicornis*? pp. 411, 499, 502. =*Lætmatonice armata* V.

*Lepidonotus squamatus*, pp. 41, 43.

*Eunoa* *Ørstedii*, pp. 41, 43, 411, 502. (*Ørstedii* Mgn.)

• *Eunoa nodosa*, p. 502.

*Nychia cirrosa*, p. 439. (see errata, p. 46.) =*Eunoa* *Ørstedii*.

*Harmothoë imbricata*, pp. 39, 43, 45, 411, 502.

*Nychia Amondseni*, pp. 407, 411.

*Antinoë Sarsii*, p. 411, 502.

*Enipo gracilis*, sp. nov., pp. 407, 411, (pl. 6, fig. 4.)

*Pholoë minuta*, pp. 439, 45, 411.

- Leanira tetragona*, pp. 407, 411.  
*Nephtys ingens*, pp. 45, 411, 502. = *Nephtys incisa* Mgn.  
*Nephtys ciliata*, p. 411, pl. 4, fig. 4.  
*Phyllodoce*, sp., pp. 43, 45, 411.  
*Phyllodoce Grœnlandica*, pp. 411, 502.  
*Phyllodoce catenula* V., pp. 39, 43, 45, 131, pl. 4, fig. 5.  
*Eulalia pistacia*, pp. 43, 45, 131, pl. 5, fig. 2.  
*Eteone pusilla*, p. 45.  
*Eteone depressa*, p. 411.  
*Nereis pelagica*, pp. 39, 43, 45, 411, 502.  
*Nereis*, sp., p. 411.  
*Nereis virens*, pp. 131, 135.  
*Autolytus cornutus*, pp. 43, 132.  
*Autolytus*, sp., p. 43.  
*Stephanosyllis picta* (nom. preoc.), sp. nov., pp. 43, 414, pl. 4, fig. 6,  
 = *Stephanosyllis ornata* V.  
*Stephanosyllis ornata*, sp. nov., p. 132.  
*Procerœa gracilis*, sp. nov., p. 43, 132, pl. 5, fig. 1.  
*Gattiola*, sp., pp. 439, 39, 411. = [*Pterosyllis cinnamata* V.]  
*Leodice vivida*, p. 411, 499, 502.  
*Nothria opalina* V., pp. 408, 411, 502, (pl. 4, fig. 1).  
*Nothria conchilega*, pp. 39, 43, 411, 499, 502 (*conchylega* Sars).  
*Ninoë nigripes* V., pp. 439, 408, 411 (pl. 4, fig. 3), 39, 45, 502.  
*Lumbriconereis fragilis*, pp. 408, 411 (pl. 4, fig. 2), 39, 45, 502.  
 (*Lumbrinereis*.)  
*Goniada maculata*, pp. 45, 411, 502.  
*Rhynchobolus albus*, pp. 45, 411, 502.  
*Rhynchobolus dibranchiatus*, pp. 132, 135.  
 = [*Euglyocera dibranchiata* V.]  
*Eumenia crassa*, p. 411.  
*Scalibregma inflatum*, pp. 439, 411.  
*Travisia*, sp., p. 411.  
*Brada*, sp., p. 411.  
*Brada sublævis*, p. 502.  
*Tecturella flaccida*, pp. 43, 411, 502. = *Flabelligera affinis* Sars.  
*Trophonia aspera*, pp. 43, 45, 411, 499, 502.  
*Ophelia*, sp., pp. 45, 411.  
*Ammotrypane fimbriata*, pp. 439, 45, 411, pl. 7, fig. 5.  
*Sternaspis fossor*, pp. 439, 43, 45, 411.  
*Scolecopsis cirrata*, p. 411 (*Scololepis*).  
*Polydora*, sp., (in shell), pp. 43, 45. = *Polydora concharum* V.

- Anthostoma acutum* V., pp. 439, 39, 45, 411. =[*Scoloplos acutus* V.]  
*Cirratulus cirratus*, p. 43, 132.  
*Chætozone setosa*, pp. 439, 411.  
*Dodecaceria concharum*, p. 411.  
*Maldane Sarsii*, pp. 439, 43, 45, 411 (Sarsi Mgn.).  
*Praxilla gracilis*, p. 411. =[*Praxillella gracilis* V.]  
*Praxilla prætermisssa*, p. 411. =[*Praxillella prætermisssa* V.]  
*Praxilla zonalis* V., sp. nov., p. 505, pl. 6, fig. 2.  
 =[*Praxillella zonalis* V.]  
*Clymenella torquata*, p. 132, pl. 7, fig. 6.  
*Nicomache*, sp. nov., viii, p. 43.  
*Nicomache lumbricalis*, pp. 439, 43, 45, 411, 502.  
*Ammochares*, sp., p. 411.  
*Notomastus latericeus*, p. 411. (latericius.)  
*Ancistria acuta* V., sp. nov., p. 505, pl. 6, fig. 3.  
 =[*Notomastus acutus* V., 1879.  
*Arenia*, sp. in capillary tubes, sp. nov., pp. 439, 411.  
 =[*Notomastus capillaris* V., 1879.]  
*Cistenides granulatus*, pp. 39, 43, 45, 411, 502.  
 =[*Pectinaria granulata*.]  
 Cistenides Gouldii, p. 45. =[*Pectinaria Gouldii* V.]  
*Ampharete gracilis*, pp. 439, 39, 45, 411.  
*Ampharete Finmarchica*, p. 411.  
*Amphiteis Gunneri*, pp. 45, 411.  
*Amage auricula*, p. 411.  
*Samytha sexcirrata*, p. 411, 502.  
*Samythella elongata* V., p. 411.  
*Melinna cristata*, pp. 439, 39, 45, 411.  
*Terebellides Ströemi*, pp. 439, 411, 502. (Strömi Sars.)  
*Pista cristata*, pp. 439, 408, 411, 502 (pl. 5, fig. 3).  
*Scione lobata*, pp. 39, 43.  
*Grymæa spiralis* V., sp. nov., p. 407 (cut. 1, descr.) 411, pl. 5, fig. 4.  
*Thelepus cincinnatus*, pp. 39, 43, 411, 499, 502.  
*Amphitrite cirrata*, pp. 439, 41, 43, 45, 411, 503, pl. 6, fig. 5.  
*Amphitrite Johnstoni*, pp. 439, 411. =*Amphitrite brunnea* Stimp.  
*Amphitrite Grœnlandica*, pp. 439, 39, 411.  
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*Polycirrus*, sp., vii, pp. 43, 45, 411.=[*Polycirrus phosphoreus* V., 1879.]  
*Potamilla oculifera*, pp. 439, 39, 43, 412, 499, 503.  
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- Sabella, sp., pp. 39, 503.  
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 Fabricia Leidyi, pp. 132, 135. =Fabricia stellaris Bv.  
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*Filigrana implexa*, pp. 43, 503. [fig. 1.  
 Vermilia serrula, pp. 439, 41, 43, 412, 499, fig. 3 (tube), 503, pl. 6,  
 Spirorbis lucidus, pp. 39, 43, 412, 503.  
 Spirorbis nautiloides, pp. 43, 503. =Spirorbis Stimpsoni.  
 Spirorbis quadrangularis, pp. 41, 43, 503.  
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 =[Phascolosoma eremita Sars.]  
 Phascolosoma cæmentarium, pp. 439, 43, 45, 412, 503.  
 =[Phascolion strombi Theel.]  
 Phascolosoma tubicola, pp. 439, 412. =[Phascolion tubicola V.]  
*Thalassema*, sp., p. 412. =Thalassema viridis V.  
*Priapulus*, sp., p. 412. =Priapulus pygmæus V.  
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 =Chætoderma nitidulum.

1874.—W. C. M'INTOSH. *The Annelids of the Gulf of St. Lawrence, Canada.* <Annals and Magazine of Natural History, April, 1874.  
 [pp. 261–270, pl. ix, x, setæ.]

The species included in this paper were collected by Mr. Whiteaves, mostly in the deeper parts of the Gulf.

#### *List of Species.*

- Aphrodita aculeata, p. 261.  
 Lætmatonice filicornis Kinb., p. 261.  
 Lepidonotus squamatus, p. 261.  
*Nychia cirrosa*, p. 262.  
 Nychia Amundseni Mgn., p. 262.  
 Eunoa Oerstedii Mgn., p. 262. (Oerstedii Mgn.)  
*Lagisca rarispina*, var. *occidentalis*, var. nov., p. 262, pl. ix, figs. 1–4.  
*Malmgrenia Whiteavesi*, sp. nov., p. 263, pl. ix, figs. 5–7.  
 Antinoë Sarsi, p. 263.  
*Eupolynoë occidentalis*, sp. nov., p. 264, pl. ix, figs. 8–13.  
 ?=Eucranta villosa Mgn.  
*Eupolynoë anticostiensis*, sp. nov., p. 265, pl. x, figs. 1–4.

*Nemidia* (?) *canadensis*, sp. nov., p. 265, pl. x, figs. 5-8.

*Nemidia* (?) *Lawrencii*, sp. nov., p. 266, pl. x, figs. 9-11.

*Polynoë gaspéensis*, sp. nov., p. 267, pl. ix, figs. 14, 15, pl. x, figs. 12, 13.

*Sthenelais limicola* Ehl., p. 268.

*Leanira tetragona* (Ørst.), p. 268.

*Leanira Yhleni* (?) Mgn., p. 268, pl. x, fig. 14.

*Pholoë minuta*, p. 269.

1874.—J. F. WHITEAVES. *Report on Deep-Sea Dredging Operations in the Gulf of St. Lawrence* [1873]. Montreal, 1874; pp. 1-29.

In this, the third Report of this series, Mr. Whiteaves records a few additional species, on p. 14.

*Priapulus caudatus* Lam. Off Gaspé, etc.

*Priapulus*, sp. Off Port Hood, N. B.

*Phascolosoma cæmentarium* Qtf. Northumberland Straits, etc.

= [*Phascolion strombi*].

1874.—A. E. VERRILL. *Explorations of Casco Bay by the U. S. Fish Commission, in 1873.* < *Proceedings of the American Association for the Advancement of Science. Portland Meeting, August, 1873,* [pp. 340-395; pl. 1-6]. Salem, June, 1874.

#### *List of Species.*

*Cryptonota citrina*, pp. 362. = *Spinther citrinus* V.

*Euprosyne borealis*, pp. 358.

*Aphrodita aculeata*, pp. 351, 367.

*Lætmonice filicornis*, pp. 351. = *Lætmatonice armata* V.

*Lepidonotus squamatus*, pp. 358, 362, 370, 373.

*Eunoa Ørstedii*, pp. 351, 358, 362, 370. (Ørsted Mgn.)

*Eunoa nodosa*, pp. 351.

*Harmothoë imbricata*, pp. 351, 355, 357, 362, 367, 370.

*Antinoë Sarsii*, p. 351.

*Enipo gracilis* V., 351, 361, 362, 373 (descr.), pl. 5, fig. 3.

*Pholoë minuta*, pp. 351, 367.

*Nephthys ingens*, pp. 351, 357, 367, 373, pl. 2, fig. 2.

= *Nephthys incisa* Mgn.

*Nephthys ciliata*, pp. 351, 367, pl. 5, fig. 7.

*Nephthys cæca*, p. 370.

*Phyllodoce catenula*, pp. 355, 358, 361, 362, 367, 370, 380 (descr.), pl. 3, fig. 1.

*Phyllodoce*, sp., pp. 351, 367.



*Phyllodoce Grœnlandica*, p. 351.

*Eulalia pistacia*, pp. 361, 362, 367, 370, 380 (descr.), pl. 4, fig. 2.

*Eteone pusilla*, p. 367.

*Eteone depressa*, p. 351.

*Nereis pelagica*, pp. 351, 355, 362, 367, 370, pl. 3, figs. 3, 4.

*Nereis limbata*, p. 373.

*Nereis virens*, pp. 370, 373, pl. 5, figs. 1, 2.

*Autolytus*, sp., p. 362.

*Autolytus cornutus*, pp. 362, 370, 373.

*Stephanosyllis picta* (typ. error), pp. 361, 362.

=*Stephanosyllis ornata* V.

*Stephanosyllis ornata* V., pp. 370, 378 (descr.), pl. 4, fig. 1.

*Proceræa gracilis*, pp. 361, 362, 370, 379 (descr.), pl. 3, fig. 2.

*Gattiola*, sp., pp. 351, 355.

=*Pterosyllis cincinnata* V.]

*Gattiola cincinnata* V., sp. nov., p. 394, pl. 2, fig. 1.\*

=*Pterosyllis cincinnata* V.]

*Leodice vivida*, p. 351.

*Nothria opalina*, pp. 351, 381 (descr.), pl. 4, fig. 4.

*Nothria conchylega*, pp. 351, 355, 362.

*Ninoë nigripes*, pp. 351, 355, 367, 382 (descr.), pl. 3, fig. 5.

*Lumbriconereis fragilis*, pp. 351, 355, 367, 370, pl. 5, fig. 6. (*Lumbrinereis*).

*Lumbriconereis obtusa*, pp. 367, 370, 383 (descr.).

=*Lumbrinereis hebes* V.

*Goniada maculata*, pp. 351, 367.

*Rhynchobolus albus*, pp. 351, 367.

*Rhynchobolus dibranchiatus*, pp. 370, 373.

=*Euglycera dibranchiata* V.]

*Scalibregma inflatum*, p. 351.

*Travisia*, sp., p. 351.

=*Travisia Forbesi*.

*Brada*, sp., p. 351.

*Brada granosa*, p. 362.

*Tegetrella flaccida*, pp. 351, 362.

=*Flabelligera affinis* Sars.

*Trophonia aspera*, pp. 351, 362, 367.

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\* Although this figure was correctly drawn by Mr. Emerton, several errors were introduced by the wood-engraver. The occipital 'epaulets,' which are made to look like eyes, are really small, but prominent, flattened processes, having a very distinct, dark border. The first dorsal cirrus on the left side, is wrongly made to appear to arise from the buccal segment, and the bases of the tentacular cirri are not well represented. In this species the ventral cirri of the first two segments are short, thick, flattened, ovate, and brownish in color. I have, therefore, reproduced this drawing more correctly on one of the accompanying plates.

*Ophelia* sp., p. 351.

*Ammotrypane fimbriata*, pp. 351, 367, pl. 2, fig. 3.

*Sternaspis fossor*, pp. 351, 362, 367.

*Scolecolepis cirrata*, pp. 351, 367, (*Scololepis*).

*Polydora*, sp., pp. 362, 367.

*Anthostoma fragilis*, p. 370. = [*Scoloplos fragilis* V.]

*Anthostoma acutum* V., pp. 351, 355, 367, 384 (descr.).

= [*Scoloplos acutus* V.]

*Anthostoma*, sp., p. 351.

= [*Scoloplos*, sp.]

*Cirratulus cirratus*, pp. 361, 362, 367, 370.

*Chætozone setosa*, pp. 351, 367.

*Dodecaceria concharum*, pp. 351, 362.

*Maldane Sarsii*, pp. 351, 367.

*Rhodine Loveni*, pp. 351, 367.

*Axiothea catenula* (typ. error), p. 351. = *Axiothea catenata* Mgn.

*Praxilla gracilis*, pp. 351, 367. = [*Praxillella gracilis* V.]

*Praxilla prætermisssa*, p. 351. = [*Praxillella prætermisssa* V.]

*Praxilla zonalis*, p. 384 (descr.), pl. 5, fig. 4. = [*Praxillella zonalis* V.]

*Praxilla zonata* (typ. error), pp. 357, 361, 362, 367.

= [*Praxillella zonalis* V.]

*Clymenella torquata*, pp. 367, 370.

*Nicomache lumbricalis*, pp. 351, 355, 362, 367.

*Ammochares*, sp., p. 351.

*Notomastus latericeus* (Sars, typ. error ?), p. 351. = *Notomastus latericius*.

*Notomastus luridus*, p. 370.

*Areniella filiformis* V., sp. nov., pp. 367, 386 (descr.).

*Ancistria capillaris* V., sp. nov., pp. 351, 355, 367, 385 (descr.).

= [*Notomastus capillaris* V., 1879.]

*Ancistria acuta*, pp. 367, 386 (descr.). = [*Notomastus acutus* V., 1879.]

*Cistenides Gouldii*, p. 367. = [*Pectinaria Gouldii* V.]

*Cistenides granulatus*, pp. 351, 355, 362, 367, 370.

= [*Pectinaria granulata*.]

*Ampharete gracilis*, pp. 351, 355, 367.

*Ampharete Finmarchica*, pp. 351, 367.

*Amphicteis Gunneri*, pp. 351, 367.

*Amage auricula*, p. 351.

*Samytha sexcirrata*, p. 351.

*Melinna cristata*, pp. 351, 355, 367.

*Terebellides Stroemi*, pp. 351, 357.

*Pista cristata*, pp. 351, 357.

- Scione lobata*, pp. 355, 358, 361, 362, 367.  
*Grymæa spiralis* V., pp. 351, 387 (descr.), pl. 5, fig. 5.  
*Thelepus cincinnatus*, pp. 351, 355, 358, 362.  
*Amphitrite cirrata*, pp. 351, 358, 362, 367.  
*Amphitrite Johnstoni*, p. 351.      = *Amphitrite brunnea* Stimp.  
*Amphitrite brunnea*, pp. 367, 370.  
*Amphitrite Grœnlandica*, pp. 351, 355.  
*Amphitrite intermedia*, pp. 351, 362, 367.  
*Polycirrus*, sp., p. 351.      = [*Polycirrus phosphoreus* V., 1879.]  
*Potamilla oculifera*, pp. 351, 355, 358, 362, 370.  
                                          = *Potamilla reniformis* Mgn.  
*Sabella zonalis*, pp. 351, 362.  
*Chone*, sp., pp. 351, 355, 362, 367.  
*Euchone elegans* V., pp. 351, 362, 367.  
*Fabricia Leidyi*, pp. 370, 373.      = *Fabricia stellaris* Blainv.  
*Myxicola Steenstrupii*, pp. 351, 362, 370.  
*Protula media*, p. 351.  
*Filigrana implexa*, p. 362.  
*Vermilia serrula*, pp. 351, 355, 358, 361, 362, pl. 4, fig. 3.  
*Spirorbis lucidus*, pp. 351, 355, 358, 362.  
*Spirorbis quadrangularis*, pp. 358, 362.  
*Spirorbis nautiloides* (?), p. 362.      = *Spirorbis Stimpsoni* V.  
*Spirorbis borealis*, pp. 370, 373.  
*Clitellio irrorata*, p. 370.  
*Halodrillus littoralis*, p. 370.  
*Phascolosoma boreale* (?), pp. 351, 367.  
                                          = [*Phascolosoma eremita* Sars.]  
*Phascolosoma cæmentarium*, pp. 351, 355, 362, 387 (descr.).  
                                          = [*Phascolion strombi* Theel.]  
*Phascolosoma tubicola* V.,\* pp. 351, 355, 388 (descr.).  
                                          = [*Phascolion tubicola* V.]  
*Priapul*us, sp., p. 351.      = *Priapul*us pygmæus V.  
*Chætoderma nitidulum*, pp. 351, 367, pl. 6, fig. 6.

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\* This species appears to be identical with the *Phascolion Spetsbergense* Theel, 1875. (K. Svenska Vet. Akad. Handlingar, iii, 6, p. 16, [sep.], pl. 1, figs. 2, 3.) The latter is regarded as a variety of *P. strombi*, by Danielssen and Koren.

1874.—S. I. SMITH and OSCAR HARGER. *Report on the Dredgings in the region of George's Banks, in 1872.* <Trans. Conn. Acad., iii, [pp. 1-57, pl. 1-8]. New Haven, July-Aug., 1874.

The identifications and descriptions of the annelids in this paper were by A. E. Verrill. The list includes not only the species from the banks, but also many from the deep water of the Gulf of Maine, and some from the deep water south of the banks, and from Nova Scotia.

### *List of Species.*

- Aphrodite aculeata Linné, pp. 4, 5.  
 Lætmatonice filicornis Kinb., p. 22.      =Lætmatonice armata V.  
 Nychia cirrosa Malmg., p. 12.  
 Eunoa nodosa Malmg., p. 12.  
 Lagisca propinqua, p. 20.  
 Lagisca rarispina Malmg., p. 14.  
 Harmothoë imbricata Malmg., pp. 5, 8, 12, 20, 22.  
 Lænilla (?) mollis G. O. Sars, pp. 16, 35 (descr.).  
 Antinoë Sarsi Kinberg, pp. 18, 37 (descr.).  
 Antinoë angusta V., sp. nov., pp. 22, 36.  
 Eucrante villosa Malmg., pp. 22, 37 (descr.).  
 Pholoë minuta Örsted, p. 16.  
 Nephthys ciliata Rathke, p. 16, pl. 5, fig. 1.  
 Nephthys ingens Stimp., pp. 16, 18, 22, 39 (descr.).  
                                          =Nephthys incisa Mgn.  
 Nephthys circinata V., sp. nov., pp. 11, 18, 38.  
 Phyllodoce catenula V., pp. 5, 39, pl. 4, fig. 3.  
 Phyllodoce, sp., p. 16.  
 Eteone depressa Malmg., p. 16.  
 Eusyllis phosphorea V., sp. nov., pp. 20, 39, pl. 7, fig. 2.  
 Nereis pelagica Linné, pp. 4, 6, 12, 16, 20.  
 Leodice vivida (Stimp.) V., pp. 11, 16, 20, 41, pl. 5, fig. 5.  
 Nothria conchylega Malmg., pp. 10, 12, 16, 18, 20, 22, 41, pl. 7, fig. 3.  
 Nothria opalina V., pp. 16, 22, 41, pl. 7, fig. 4.  
 Ninoë nigripes V., pp. 16, 40, pl. 5, fig. 3.  
 Lumbriconereis fragilis Aud. and Edw., pp. 11, 16, 18, 22, pl. 5, fig. 2, (Lumbrinereis).  
 Goniada maculata Örsted, pp. 16, 22, 42.  
 Rhynchobolus capitatus V., pp. 8, 11, 16, 17, 43.  
 Ammotrypane fimbriata V., pp. 16, 18.  
 Eumenia crassa Örsted, pp. 16, 18.

*Scalibregma inflatum* Rathke, p. 22.

*Trophonia aspera* (Stimp.) V., pp. 16, 18.

*Brada*, sp., p. 15.

*Sternaspis fossor* Stimp., pp. 16, 18.

*Scolecoplepis cirrata* Malmg., pp. 16, 22, (*Scololepis*).

*Spiochætopterus* (? tubes), pp. 12, 22. Doubtful.

*Dodecaceria concharum* Ærsted, p. 21.

*Chætozone setosa* Malmg., p. 18.

*Notomastus latericius* p. 16, (*latericeus* Sars, typ. error?)

*Ancistria capillaris* V., pp. 16, 19, 22.

= [*Notomastus capillaris* V., 1879.]

*Maldane Sarsii* Malmg., pp. 16, 19, 22.

*Axiothea catenata* Malmg., p. 16.

*Rhodine Loveni* Malmg., pp. 16, 19.

*Nicomache lumbricalis* Malmg., p. 16.

*Praxilla prætermisssa* Malmg., pp. 16, 19.

= [*Praxillella prætermisssa* V.]

*Praxilla gracilis* Malmg., p. 16.

= [*Praxillella gracilis* V.]

*Praxilla*, sp., p. 16.

*Clymenella torquata* V., p. 4.

*Ammochares assimilis* Sars, pp. 16, 19, 20, pl. 5, fig. 4.

*Cistenides granulata* Malmg., pp. 3, 6, 12, 23, (*granulatus*).

= [*Pectinaria granulata*.]

*Ampharete gracilis* Malmg., p. 17.

*Ampharete Finmarchica* Malmg., p. 17.

*Ampharete arctica* Malmg., pp. 16, 19.

*Amphicteis Gunneri* Malmg., pp. 17, 23.

*Amphicteis Sundevalli* Malmg., p. 19.

*Samytha sexcirrata* Malmg., pp. 17, 43.

*Samythella elongata* V., pp. 17, 22 (descr.).

*Amage auricula* Malmg., p. 23.

*Melinna cristata* Malmg., pp. 17, 23.

*Amphitrite cirrata* Müller, p. 17.

*Amphitrite Grönlandica* Malmg., p. 20.

*Pista cristata* Malmg., pp. 17, 23, pl. 4, fig. 2.

*Thelepus cincinnatus* Malmg., pp. 6, 8, 12, 20.

*Grymæa spiralis* V., pp. 17, 23, 44 (descr.), pl. 4, fig. 1.

*Terebellides Stroemi* Sars, pp. 17, 19, 23.

*Polycirrus*, sp., pp. 17, 19.

= [*Polycirrus phosphoreus* V., 1879.]

*Potamilla oculifera*, pp. 6, 12.

= *Potamilla reniformis*.

*Potamilla neglecta*, pp. 6, 12, 17, 44.

*Sabella pavonia* (?), p. 17.

*Chone infundibuliformis* Kröyer, p. 20.

*Protula media* Stimp., pp. 17, 46, pl. 6, fig. 1.

*Protula borealis* (?), pp. 17, 23, 46.      ?=*Protula media*, var.

*Spirorbis valida* V., sp. nov., pp. 12, 44, (validus).

      =*Spirorbis validus* V.

*Spirorbis nautiloides* (?) Lamk., pp. 6, 8, 20, 45 (deser.), pl. 4, fig. 4.

      =*Spirorbis Stimpsoni* V.

*Spirorbis lucidus* Mörch, p. 12.

*Spirorbis quadrangularis* Stimp., p. 21.

*Phascolosoma boreale* Kef., pp. 17, 23, 47.

      =[*Phascolosoma eremita* Sars.]

*Phascolosoma cæmentarium* Quatr., pp. 6, 12, 17, 19, 23, 46.

      =[*Phascolion strombi* Theel.]

*Phascolosoma tubicola* V., pp. 11, 17, 23, 46.

      =[*Phascolion tubicola* V.]

*Chætoderma nitidulum* Lov., p. 17, pl. 8, figs. 3, 4.

1874.—A. E. VERRILL. *Notice of some Dredgings made near Salem by Dr. A. S. Packard, Jr., and C. Cooke, in 1873.* <*Sixth Annual Report of the Peabody Academy of Science, Salem, Mass.*

#### *List of Species.*

*Lepidonotus squamatus*, p. 60.

*Harmothoe imbricata*, p. 60.

*Nephtys ingens*, p. 60.

      =*Nephtys incisa* Mgn.

*Amphitrite brunnea*, p. 60.

*Cistenides Gouldii*, p. 60.

      =[*Pectinaria Gouldii* V.]

*Spirorbis lucidus*, p. 60.

*Phascolosoma cæmentarium*, p. 59.

      =[*Phascolion strombi* Theel.]

1875.—A. E. VERRILL. *Brief Contributions to Zoology from the Museum of Yale College. No. XXXII.—Results of Dredging Expeditions off the New England Coast, in 1874.* <*American Journal of Science and Arts, vol. ix, [pp. 411-415], June, 1875.*

This contains an account of the dredgings made in the Gulf of Maine, on Jeffrey's Bank, Jeffrey's Ledge, Cashe's Ledge, etc., by Messrs. A. S. Packard, Jr., Richard Rathbun and C. Cooke, on the Coast Survey steamer "Bache," Capt. Platt, commander, for the U. S. Fish Commission. The list included only species additional to those previously dredged in the same region.

*List of Species.*

*Euphrosyne borealis*, p. 415.

*Eunoa nodosa*, p. 415.

*Lagisca rarisipina*, p. 414.

*Nephthys circinata* V., p. 414.

*Ancistria capillaris*, p. 415. = [*Notomastus capillaris* V., 1879.]

*Amphitrite Grayi*, p. 415.

*Amphitrite intermedia*, p. 415.

*Grymæa spiralis* V., p. 414.

*Sabella neglecta* (?), p. 414. = *Potamilla neglecta* Mgn.

*Spirorbis valida* V., p. 414 (*validus*).

1875.—A. E. VERRILL. *Brief Contributions to Zoology from the Museum of Yale College. No. XXXIII.—Results of Dredging Expeditions off the New England Coast, in 1874.* [Nos. 2, 3]. < *American Journal of Science and Arts*, vol. 2, [pp. 36–43, July, 1875; pp. 196–202, pl. iii, iv, Sept., 1875].

These articles contain an account of the dredgings made in the eastern part of Long Island Sound, Fisher's Island Sound, near Block Island, off Stonington, Conn., etc., with tables of localities and temperatures, and lists of species added to the fauna.

*List of Species.*

*Sthenelais*, sp. nov., p. 39.

= *Sthenelais Emertoni* V.

*Pholos minuta*, p. 39.

*Nephthys cæca*, p. 39.

*Phyllodoce Grœnlandica*, p. 39.

*Proceræa gracilis*, p. 39.

*Eusyllis lucifera* V., sp. nov., p. 39. = [*Odontosyllis lucifera* V., 1879.]

*Syllis pallida* V., sp. nov., p. 39, pl. 3, fig. 6.

*Syllis*, sp., p. 39.

*Lumbriconereis obtusa* V., sp. nov., p. 39. (nom. preoc.)

= [*Lumbrinereis hebes* V., 1879.]

*Lumbriconereis acuta* V., sp. nov., p. 39, pl. 3, fig. 5.

= *Lumbrinereis acuta* V.

*Ophelia denticulata* V., sp. nov., p. 39.

*Arenicola marina*, p. 39.

*Trophonias aspera*, p. 39.

*Brada*, sp., p. 39.

*Polydora*, sp., p. 39.

= *Dipolydora concharum* V., 1879.

*Polydora*, sp., p. 39.

= [*Polydora gracilis* V., 1879.]

Praxilla, sp., p. 39.

Ancistria capillaris, p. 39.                   =[Notomastus capillaris V., 1879.]

Cistenides granulatus, p. 39.                   =[Pectinaria granulata.]

Thelepus cincinnatus, p. 39.

Polycirrus, sp., p. 39.                   =[Polycirrus phosphoreus V., 1879.]

Pista cristata, p. 40.

Chone, sp., p. 40.

Filigrana implexa, p. 40.

Spirorbis nautiloides ? Lam., p. 40.

=Spirorbis Stimpsoni V., 1879.

Spirorbis, sp., p. 40.

1876.—F. M. TRUMBULL. *On the Anatomy and Habits of Nereis virens.* <Trans. Conn. Acad., iii, [pp. 265–280, pl. 42–44]. August, 1876.

This paper includes only the species named in the title. The sexual differences, in this species, are here first described and illustrated. The anatomical details relate chiefly to the external organs and to the circulatory and digestive systems.

1876.—W. C. M'INTOSH, in Jeffreys and Carpenter. *The Valorous Expedition. Preliminary Report of the Biological Results of a Cruise in H. M. S. 'Valorous' to Davis Strait in 1875.* <Proceedings of the Royal Society, xcn, [pp. 177–237]. London, 1876. [Annelids, pp. 215–222.]

Lists of the species identified by Mr. M'Intosh, from the collection made in the Gulf of St. Lawrence by Mr. Whiteaves, are given on p. 222, and compared with those dredged by the Valorous Expedition, off the coast of Greenland. No special depths or localities are given for the Gulf of St. Lawrence species. Part of the species here enumerated from the Gulf of St. Lawrence are not included in the lists previously published. [See pp. 298, 306, 307, above.] On the other hand, some of those in the former lists were omitted from this.

*List of Species not included in former reports.*

*Leanira hystrix*.

?=L. Yhleni ?, see p. 307.

*Nephtys incisa*.

*Phyllodoce Grönlandica*.

*Nereis pelagica*.

*Onuphis sicula*.



- Glycera capitata. = *Rhynchobolus capitatus*.  
 Scoloplos armiger.  
 Ophelia limacina.  
 Scalibregma inflatum.  
 Eumenia crassa.  
 Scolecolepis cirrata.  
*Prionospio Steenstrupi*.  
*Capitella capitata*. (Doubtful).  
 Maldane Sarsi.  
 Nicomache lumbricalis.  
 ? *Axiothea catenata*.  
*Owenia filiformis*.  
*Cystenides hyperborea* (Cistenides Mgn.) = *Pectinaria hyperborea*.  
*Artacama proboscidea* Mgn.  
*Sabella saxicava* ?  
 Chone infundibuliformis.  
 Sternaspis.

The following species, enumerated in this paper, are included in the lists published previously (see pp. 298, 306, 307): *Aphrodita aculeata*, *Lætmonice filicornis*, *Nychia cirrosa*, N. Amundseni, *Ennoa Oerstedii*, *Eupolynoë occidentalis*, *Lepidonotus squamatus*, *Lagisca rarispina*, var., *Malmgrenia Whiteavesii*, *Antinoë Sarsi*, *Nemidia canadensis*, N. *Lawrencii*, *Polynoë Gaspéensis*, *Sthenelais limicola*, *Leanira tetragona*, *Pholoë minuta*, *Nothria conchylega*, *Lumbriconereis fragilis*, *Goniada maculata*, *Ephesia gracilis*, *Ammotrypane aulogaster*, *Trophonia plumosa*, *Praxilla gracilis*, *Thelepus circinnatus* (*cinnatus*), *Terebellides Strömii*, *Sabella pavonia*.

1879.—A. E. VERRILL, in *Kumlin. Contributions to the Natural History of Arctic America, made in connection with the Horegate Polar Expedition, 1877-78. Annelids, pp. 141-148.* < *Bulletin U. S. National Museum, No. 15, 1879.*

The species included in this paper were all from Cumberland Gulf and Cumberland Sound. They were mostly collected on the shores, between tides.

#### *List of Species.*

- Harmothoë imbricata* Mgn., p. 141.  
*Nereis pelagica* Linné, p. 141.  
*Phyllodoce Grönlandica* Oersted ?, p. 141.

*Syllis*, sp.,

*Cistenides granulata* Mgn., p. 141. = [*Pectinaria granulata*].

*Thelepus cinnatus* (Fabr.) V., p. 141.

*Spirorbis lucidus* Mörch, p. 142.

*Spirorbis quadrangularis* Stimp., p. 142.

*Phascolosoma margaritaceum* (Sars) Kor. & Dan. (?), p. 142.

1879.—H. E. WEBSTER. *On the Annelida Chaetopoda of the Virginian Coast* [pp. 1-69, plates 1-11]. < *Transactions of the Albany Institute*, vol. ix, pp. 202-269, Jan., 1879.

The species enumerated were from Northampton Co., Virginia, (eastern shore), and are all shallow water and shore species.

*List of Species belonging to the New England Fauna.*

*Lepidonotus squamatus* Kinbg., p. 204 [4], pl. 1, figs. 1-5.

*Lepidonotus squamatus*, var. *angustus*, p. 205 [5].

*Lepidometria commensalis*, n. sp., p. 210 [10], pl. 3, figs. 23-31.

*Sthenelais picta* Verrill, p. 213.

*Nephtys ingens* Stimpson, p. 213. = *Nephtys incisa* Mgn.

*Nephtys picta* Ehlers, p. 214.

*Podarke obscura* Verrill, p. 216.

*Syllis fragilis*, sp. nov., p. 217, pl. 4, figs. 42, 43.

*Sphaerosyllis fortuita*, sp. nov., p. 221, pl. 4, figs. 44-48.

*Pædophylax dispar*, sp. nov., p. 223, pl. 4, fig. 49, pl. 5, figs. 50-55.

*Nereis virens* Sars, p. 235.

*Nereis limbata* Ehlers, p. 235, pl. 6, figs. 70-75.

*Diopatra cuprea* Clpd., p. 236.

*Marphysa sanguinea* Quatr., p. 236, pl. 6, figs. 76-80, pl. 7, figs. 81-83.

*Drilonereis longa*, sp. nov., p. 240, pl. 7, figs. 84-88.

*Lumbriconereis tenuis* V., p. 241. (*Lumbrinereis*.)

*Arabella opalina* Verrill, p. 242.

*Staurocephalus pallidus* Verrill, p. 242 (descr.)\*

*Rhynchobolus Americanus* Verrill, p. 245.

*Spiochaetopterus oculatus*, sp. nov., p. 47, pl. 8, figs. 98-102.

*Anthostoma robustum* V., p. 258. = [*Scoloplos robustus* V.]

*Anthostoma fragile* V., p. 258. = [*Scoloplos fragilis* V.]

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\* The supposed error in the original measurement of this species, referred to by Professor Webster, is only apparent, owing to the fact that the specimens of this species contract excessively when put into alcohol. My original measurements were from the living specimens, and are correct. Still larger specimens have since been obtained.

*Cirratulus grandis* V., p. 258.

*Cymenella torquata* V., p. 258.

*Maldane elongata* V., p. 259.

*Sabellaria varians*, sp. nov., p. 259. = *Sabellaria vulgaris* V

*Amphitrite ornata* V., p. 262.

*Scionopsis palmata* V., p. 262.

*Pista cristata* Mgn., p. 263. (Doubtful.)

*Lepræa rubra* V., p. 263.

*Polycirrus eximius* V., p. 263.

*Enoplobranchus sanguineus* Verrill.

*Sabella microphthalmia* V., p. 265.

*Hydroides dianthus* Verrill, p. 266.

The following additional species, which were described, have not yet been observed on the New England coast:

*Lepidonotus variabilis*, sp. nov.; *Antinoë parasitica*, sp. nov.; *Phyllodoce fragilis* (*Phyllodoce*), sp. nov.; *Eumida maculosa*, sp. nov.; *Syllis gracilis* Grube; *Odontosyllis*? *fulgurans* Clapd.; *Autolytus hesperidum* Clapd.; *Proceræa tardigrada*, sp. nov.; *Proceræa*? *cœrulea*, sp. nov.; *Nereis irritabilis*, sp. nov.; *Nereis Dumerillii* Aud. and Edw.; *Staurocephalus sociabilis*, sp. nov.; *Trophonia arenosa*, sp. nov.; *Nerine heteropoda*, sp. nov.; *Polydora hamata*, sp. nov.; *Polydora cæca*, sp. nov.; *Aricia rubra*, sp. nov.; *Aricidea fragilis*, sp. nov.; *Ancistria minima* Quatr.; *Pectinaria* (*Lagis*) *dubia*, sp. nov.; *Melinna maculata*, sp. nov.; *Lysilla alba*, sp. nov.; *Potamilla tortuosa*, sp. nov.; *Cabira incerta*, gen. et sp. nov.; *Phronia tardigrada*, gen. et sp. nov.

1879.—A. E. VERRILL. *Preliminary Check-list of the Marine Invertebrata of the Atlantic Coast, from Cape Cod to the Gulf of St. Lawrence.* [Prepared for the United States Commission of Fish and Fisheries.] *Author's Edition, published at New Haven, June, 1879.* [*Annelida*, pp. 7-11, 32, printed August, 1878, to April, 1879.]

This list includes a few species not previously recorded from the New England coast. The rest are contained in the lists already given, and are, therefore, omitted. The total number of polychætous Annelids included in this check-list is 195; of *Gephyræa* 10. Several new species, included in the check-list, were described in the paper next to be noticed. Although the latter was in type before the printing of the check-list, it was published some months later.

*List of described Species not previously recorded.*

- Evadne impar*, p. 7.  
*Nephtys longisetosa* Cers. (non Mgn.), p. 7.  
*Nephtys paradoxa* Malm., p. 7.  
*Autolytus*, sp., p. 8. = [Autolytus Alexandri Mgn.]  
*Eusyllis monilicornis* Mgn., p. 8.  
*Nereis zonata* Mgn., p. 8.  
*Scoloplos armiger* Blainv., p. 9.  
*Ophelia limacina* Mgn., p. 9.  
*Lysippe lobata* Mgn., p. 10.  
*Leæna abbranchiata* Mgn., p. 10.  
*Lanassa Nordenskiöldi* Mgn., p. 11.  
*Artacama proboscidea* Mgn., p. 10.  
*Euchone tuberculosa* Mgn., p. 10.  
*Chone Dumeri* Mgn., p. 10.

*List of New Species.*

- Sigalion*, sp., p. 7. =*Sigalion arenicola* V., p. 32.  
*Sthenelais*, sp., p. 7. =*Sthenelais gracilis* V., p. 32.  
*Lysilla*, sp., p. 10.  
*Polycirrus*, sp., p. 10. =[*Polycirrus phosphoreus* V.]  
*Laematonice armata* V., sp. nov., p. 11.  
*Eunoea spinulosa* V., p. 11.  
*Sthenelais Emertoni* V., p. 11.  
*Heterocirrus fimbriatus* V., 11.  
*Polydora concharum* V., p. 32. =[*Dipolydora concharum* V.]  
*Thalassema viridis* V., p. 11.  
*Priapulius pygmaeus* V., p. 11.

The following changes in nomenclature were introduced in the Check-List:

- Arabella opalina* V., p. 8. = *Lumbriconereis opalina* V., 1873.  
*Enoplobranchus sanguineus* V., p. 10. = *Chætobranchus sanguineus* V., 1873.  
*Hydroides dianthus* V., p. 11. = *Serpula dianthus* V., 1873.

- 1879.—A. E. VERRILL. *Notice of Recent Additions to the Marine Invertebrata of the Northeastern Coast of America, with Descriptions of new Genera and Species, and Critical Remarks on others. Part I.—Annelida, Gephyrea, Nemertina, etc.* <Proceedings of United States National Museum, vol. ii [pp. 165–205. Nov., 1879].

*List of Species.*

- Sthenelais gracilis* V., sp. nov., p. 166.  
*Sthenelais Emertoni* V., sp. nov., p. 166.  
*Sthenelais picta* V., p. 167 (descr.)  
*Sigalion arenicola* V., sp. nov., p. 167.  
*Laetmatonice armata* V., sp. nov., p. 168.  
*Eunoa spinulosa* V., sp. nov., p. 169.  
*Autolytus ornatus* V., sp. nov., p. 170 (name preoccupied).  
 =[*Autolytus varians* V., nom. nov.]  
*Odontosyllis lucifera* V., p. 170 (*Eusyllis lucifera* V., 1875).  
*Pædophylax longiceps* V., sp. nov., p. 170.  
*Nereis alacris* V., sp. nov., p. 171.  
 =[*Nereis megalops* V., nereis-form.]  
*Nereis megalops* V., p. 172 (*Nectonereis megalops* V., 1873.)  
*Ceratocephale Websteri* V., sp. nov., p. 172.  
*Lumbrinereis hebes* V., p. 174 (*L. obtusa* V., 1875, name preoccupied).  
*Goniada gracilis* V., p. 174 (*Eone gracilis* V., 1873).  
*Polydora gracilis* V., sp. nov., p. 174.  
*Polydora concharum* V., sp. nov., p. 174.  
 =[*Dipolydora*\* *concharum* V.]  
*Spio limicola* V., sp. nov., p. 176.  
*Spiophanes tenuis* V., sp. nov., p. 176. =[*Prionospio tenuis* V.]  
*Heterocirrus fimbriatus* V., sp. nov., p. 177.  
*Dodecaeria concharum*, p. 178 (descr.)  
*Prædillura ornata* V., gen. et sp. nov., p. 179.  
*Maldane filifera* V., sp. nov., p. 179.  
*Notomastus gracilis* V., sp. nov., p. 180.  
*Polycirrus phosphoreus* V., sp. nov., p. 181.

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\* The genus *Dipolydora* is established for this species. It differs from typical *Polydora*, especially in having four groups of setæ on each side of the large, specialized, fifth segment, showing plainly that this is composed of at least two united segments. The caudal segment bears four flattened lobes, instead of a sucker. The body is very long, and consists of an unusually large number of segments. The structure, in general, is modified to suit the habit of living in galleries excavated in shells or limestone.

- Trichobranchus glacialis*, p. 181.  
*Spirorbis Stimpsoni* V., sp. nov., p. 181.  
*Tomopteris Smithii* V., sp. nov., p. 182.  
*Priapulus pygmaeus* V., sp. nov., p. 182.  
*Thalassena viridis* V., sp. nov., p. 183.

1880.—II. E. WEBSTER. *Annelida Chaetopoda of New Jersey*, [pp. 1–28, plates not issued]. < *Thirty-second Annual Report on the New York State Museum of Natural History*, [dated 1879].

Although put in type in 1879, this paper was not actually published until 1880, and the plates that were prepared for it have not yet been published. To the author I am indebted for an advance copy, received in the autumn of 1880.

The specimens were mostly from Great Egg Harbor, N. J., but some from South Norwalk, Conn., were also included.

The new species, not in italics, have not yet been detected on the New England coast.

#### *List of the Species.*

- Lepidonotus squamatus* Kinbg., p. 1.  
*Lagisca impatiens*, sp. nov., p. 2.  
*Lepidametria commensalis* Webs., p. 3.  
*Sthenelais picta* Verrill, p. 3.  
*Nephthys incisa* Malmg., p. 4.  
*Nephthys picta* Ehlers, p. 4.  
*Anatilis speciosa*, sp. nov., p. 4, [pl. 1, figs. 8, 9].  
*Phyllodoce arenæ*, sp. nov., p. 5, [pl. 2, figs. 10–12].  
*Eumida maculosa* Webs., p. 6.  
*Eulalia?* *annulata* Verrill, p. 6.  
*Eteone alba*, sp. nov., p. 6, [pl. 2, figs. 13–16].  
*Eteone limicola* Verrill, p. 7.  
*Podarke obscura* Verrill, p. 7, [pl. 2, figs. 17, 18].  
*Podarke luteola*, sp. nov., p. 7, [pl. 2, figs. 19, 20].  
*Syllis gracilis* Grube, p. 9.  
*Odontosyllis?* *fulgurans* Clpd., p. 9.  
*Grubea tenuicirrata* Clpd., p. 9.  
*Pædophylax dispar* Webs., p. 10.  
*Autolytus hesperidum* Clpd., p. 10.  
*Nereis limbata* Ehlers, p. 11, [pl. 3, figs. 21, 22].

- Nereis Culveri*, sp. nov., p. 11, [pl. 3, figs. 23-30; pl. 4, figs. 31, 32].  
*Nereis tridentata*, sp. nov., p. 13, [pl. 4, figs. 33-40].  
*Diopatra cuprea* Clpd., p. 15.  
*Marphysa sanguinea* Quatr., p. 15.  
*Drilonereis longa* Webs., p. 16.  
*Lumbriconereis tenuis* Verrill, p. 16. (Lumbrinereis.)  
*Arabella opalina* Verrill, p. 16.  
*Staurocephalus pallidus* Verrill, p. 16.  
*Rhynchobolus Americanus* Verrill, p. 16.  
*Rhynchobolus dibranchiatus* Verrill, p. 17.  
*Goniada solitaria*, sp. nov., p. 17, [pl. 4, figs. 41, 42; pl. 5, figs. 43, 44.]  
*Arenicola* ? *cristata* Stimpson, p. 17.  
*Trophonia affinis* Verrill, p. 18.  
*Spiochætopterus oculatus* Webs., p. 18.  
*Nerine agilis* Verrill, p. 18.  
*Scolecoclepis viridis* Verrill, p. 18 (descr.).  
*Scolecoclepis tenuis* Verrill, p. 18.  
*Spio setosa* Verrill, p. 19.  
*Polydora hamata* Webs., p. 19.  
*Polydora ligni*, sp. nov., p. 19, [pl. 5, figs. 45-47].  
*Streblospio Benedicti*, gen. et sp. nov., p. 20, [pl. 5, figs. 48-50].  
*Anthostoma fragile* Verrill, p. 21. = [Scoloplos fragilis V.]  
*Cirratulus grandis* Verrill, p. 22.  
*Cirrhinereis fragilis* Qtrfg., p. 22.  
*Notomastus filiformis* Verrill, p. 23, [pl. 5, figs. 51-54].  
*Notomastus luridus* Verrill, p. 23.  
*Clymenella torquata* Verrill, p. 23.  
*Maldane elongata* Verrill, p. 24.  
*Praxilla elongata*, sp. nov., p. 24 (? Praxillella).  
*Praxilla elongata*, var. *Benedicti* Webs., p. 25.  
*Parasiothea latens*, gen., et sp. nov., p. 25, [pl. 7, figs. 62-66].  
*Sabellaria varians* Webs., p. 26. = *Sabellaria vulgaris* V.  
*Cistenides Gouldii* Verrill, p. 27. = [Pectinaria Gouldii V.]  
*Sabellides oculata*, sp. nov., p. 27, [pl. 7, figs. 67-69].  
*Amphitrite ornata* Verrill, p. 27.  
*Scionopsis palmata* Verrill, p. 28.  
*Polycirrus eximius* Verrill, p. 28.  
*Sabella microphthalma* Verrill, p. 28.  
*Hydroides dianthus* Verrill, p. 28.

- 1880.—J. H. EMERTON. *Life on the Seashore, or Animals of our Coasts and Bays.* [138 pp., 12mo., 151 cuts.] *Geo. A. Bates, Salem, Mass.*, 1880.

This work contains brief popular accounts of several annelids, with notes on their habits. Many of the figures are the same as those in the Report on the Invertebrata of Vineyard Sound, etc.

*List of Species.*

- Nereis virens*, pp. 23, 122, figs. 24–26, (after Turnbull.)  
*Clymenella torquata*, pp. 24, 121, fig. 27.  
*Cistenides Gouldii*, pp. 24, 122, fig. 28. = [*Pectinaria Gouldii*.]  
*Polycirrus eximius*, p. 25, fig. 29.  
*Lepidonotus squamatus*, p. 26, fig. 30 (original).  
*Autolytus*, sp., p. 86, fig. 106 (original). = *Autolytus cornutus*, male.  
*Trophonia affinis*, pp. 116, 121, fig. 142.  
*Diopatra cuprea*, pp. 117, 122, fig. 143.  
*Amphitrite ornata*, pp. 118, 123, fig. 134.  
*Nephtys ingens*, p. 122. = *Nephtys incisa*.  
*Nephtys cæca*, p. 122.  
*Sternaspis fessor*, p. 135, fig. 156.  
*Aphrodite aculeata*, p. 135.

- 1880.—A. E. VERRILL. *Notice of Recent Additions to the Marine Invertebrata of the Northeastern Coast of America, with Descriptions of New Genera and Species and Critical Remarks on others. Part II.—Mollusca, with notes on Annelida, Echinodermata, etc., collected by the United States Fish Commission.* < *Proceedings of United States National Museum*, iii, pp. 356–405, Dec., 1880.

This paper is devoted almost entirely to the mollusca, but in the introductory remarks some of the remarkable annelids recently discovered in the deep water (100–500 fathoms), off the southern coast of New England, are mentioned, in connection with their peculiar tubes, which occurred in vast numbers. Two of the new species are briefly described.

*List of Species.*

- Hyalinœcia artifex*, sp. nov., p. 357.  
*Nothria*, sp., p. 358.  
*Leodice polybranchia*, sp. nov., p. 358.



The notices of the following papers were omitted from their proper places. The first should have been inserted on page 291; the second, on page 296.

1860.—J. W. DAWSON. *On the Tubicolous Marine Worms of the Gulf of St. Lawrence.* < *Canadian Naturalist and Geologist*, v, [pp. 24–30, with cuts] Feb., 1860.

*List of Species.*

Spirorbis spirillum, p. 25.	=Spirorbis borealis.
Spirorbis sinistrorsa, p. 25.	?=Spirorbis lucidus, juv.
Spirorbis nautiloides, p. 25.	?=Spirorbis Stimpsoni V.
<i>Spirorbis carinata</i> , p. 26.	
Spirorbis vitrea, p. 26.	
<i>Spirorbis cancellata</i> , p. 27, fig. 1, a–e.	
Spirorbis granulata, p. 27.	
Spirorbis porrecta, p. 28.	=Spirorbis lucidus.
Serpula (Vermilia) serrula (Stimp.), p. 29 fig. 2, a–c, lateral chambers of shell.	
Pectinaria Grœnlandica? p. 29.	?=[Pectinaria granulata.]

1868.—A. S. PACKARD, JR. *A few Sea Worms.* < *Amer. Naturalist*, vol. ii, [pp. 267–275,] July, 1868.

This is a popular account of the habits and structure of a few forms, native and foreign. The New England species mentioned are as follows:

No name, p. 270, fig. 1.	=Cirratulus cirratus.
Hæmatorrhœa, p. 270, fig. 2.	=Polycirrus eximius, young.
Amphitrite cirrata, p. 271, fig. 3, (after Malmgren.)	
Pectinaria hyperborea (non Mgn.), p. 274, fig. 4.	=Pectinaria granulata, in part.
Nereis denticulata, p. 274.	=Nereis pelagica.
Nereis grandis, p. 275.	=Nereis virens.

[Printed, October 17, 1881.]

## EXPLANATION OF PLATES.

[VOLUME IV, ARTICLE VIII.]

My thanks are due to Professor S. F. Baird for the use of most of the drawings for the following plates. They were made for the use of the U. S. Fish Commission by Messrs. J. H. Emerton and J. H. Blake, under my direction.

## PLATE III.

Figure 1.—*Aphrodite aculeata* Linné. From a small, living specimen, enlarged two diameters. By J. H. Emerton.

## PLATE IV.

Figure 1.—*Lepidonotus squamatus* Leach. Head and anterior part of the body, with the proboscis protruded; one of the anterior scales has been removed to partially expose the head. Much enlarged.

Figure 1a.—The same. End view of the proboscis.

Figure 2.—*Lepidonotus sublevis* V. Dorsal view, enlarged nearly two diameters.

Figure 3.—*Marphysa leidyi* Quatr. Head and anterior part of body, dorsal view. Much enlarged.

Figure 4.—*Arabella opalina* V. Anterior part of the body, enlarged five diameters.

Figure 4a.—The same. One of the parapodia, much enlarged.

Figure 5.—*Diopatra cuprea* (Bosc). Head and anterior part of body; side view, showing the gills partially expanded. Enlarged two diameters.

Figure 5a.—The same. Ventral view, showing the pharynx everted so as to expose the jaws. Enlarged about two diameters.

. Drawn from preserved specimens, by J. H. Emerton.

## PLATE V.

Figure 1.—*Nereis megalops* V. (*Nereis*-form=*N. alacris* V.). Dorsal view of the head and anterior part of body, and of the caudal segments and cirri (1a). Enlarged about three diameters, from a living specimen, Vineyard Sound, 1875.

Figure 2.—The same. (Female, *Heteronereis*-form.) Dorsal view of head and anterior segments; the posterior dorsal tentacular cirri are broken off. Enlarged about five diameters, from a living specimen.

Figure 3.—*Nereis limbata* Ehrl. Dorsal view of the head and anterior segments, enlarged about four diameters, from a living specimen, Vineyard Sound, 1875.

Figure 3a.—The same. Caudal segments and cirri.

Figure 4.—*Phyllodoce catenula* V. Dorsal view of the entire worm, except the caudal segments, which are broken off. Enlarged about three diameters, from life.

Figure 4a.—The same. Head and protruded proboscis.

Figure 5.—*Phyllodoce Grönlandica* Örsted. Head and anterior segments, dorsal view. Enlarged about four diameters, from a living example, Eastport, Me.

Figure 6.—*Eulalia pistacia* V. Head and anterior segments, dorsal view. Enlarged about eight diameters, from life.

Figure 6a.—The same. Caudal segments and cirri.

Figures 1 and 3 are by J. H. Blake; the rest by J. H. Emerton.

## PLATE VI.

Figure 1.—*Harmothoe imbricata*. Dorsal view, natural size.

Figure 1a.—The same. Portion of a scale, enlarged twelve diameters.

Figure 1b.—The same. A small part of a scale, enlarged 190 diameters.

Figure 1c.—The same. One of the parapodia bearing dorsal cirri, enlarged ten diameters: *a'* upper, *a''* lower acicula; *dc* dorsal cirrus; *vc* ventral cirrus; *ds* dorsal setæ; *vs*, *vs'*, *vs''* ventral setæ.

Figure 1d.—The same. Setæ, enlarged 200 diameters: *d*, dorsal seta; *v*, *v'*, ventral setæ, side views; *v''*, the same, front view.

Figure 2a.—*Lepidonotus squamatus*. A scale, enlarged fourteen diameters.

Figure 2b.—The same. Portion of a scale bearing the smaller tubercles, more enlarged.

Figure 3a.—*Lepidonotus sublevis* V. A scale, enlarged twelve diameters.

Figure 3b.—The same. Portion of a scale, enlarged sixty diameters.

Figure 3c.—The same. One of the parapodia, much enlarged.

Figure 3d.—The same. Setæ, much enlarged: *d*, dorsal seta; *v*, *v'*, ventral setæ, side and front views.

Figure 4.—*Lepidonotus squamatus* ? (Young). Head and anterior part of body, with scales removed, much enlarged: *h*, cephalic lobe or head, with eyes; *a*, median antenna; *a'*, lateral antennæ; *c*, *c'*, upper and lower tentacular cirri; *p*, *p*, palpi; *dc*, dorsal cirri; *vc*, ventral cirri; *s*, dorsal and *s'*, ventral fascicles of setæ; *e*, *e*, tubercles to which the scales (elytra) were attached.

Figure 4a.—The same. A scale, enlarged eighteen diameters.

Figure 4b.—The same. One of the parapodia, enlarged fifty-six diameters; lettering as in 1c.

Figure 4c.—The same. Setæ, much enlarged; *d*, dorsal seta; *v*, ventral seta.

Figure 5.—*Polynoe* (*Eunoe*) *Acanella* Verrill. Head and anterior part of body, enlarged.

Figure 5a.—The same. Part of a scale, enlarged sixty diameters.

Figure 6.—*Loxmatonice armata* V. Head and anterior part of body, enlarged four diameters, with some of the anterior scales removed to show the head. Lettering as in fig. 1: *e''*, *e'''*, *e''''*, elytra.

Figure 6a.—The same. Ventral parapodium, showing (*vs*) four of the peculiar setæ, enlarged ten diameters.

Figure 6b.—The same. Barbed setæ of the dorsal fascicle; *d*, side view; the same, seen edgewise.

Figure 7.—*Sthenelais picta* V. Setæ of ventral fascicle, enlarged 200 diameters: *a*, semi-whorled spinulose seta from upper part of ventral fascicle; *b*, *b'*, two of the compound bidentate setæ with spinose shafts; *c*, *c'*, stouter bidentate setæ, without spinules.

The drawings are by J. H. Emerton, mostly from preserved specimens.

## PLATE VII.

Figure 1.—*Sthenelais Emertoni* V. Dorsal view of head, much enlarged. Specimen (figs. 1-1s) from Narragansett Bay, station 770, 1880. From a living specimen.

Figure 1a.—The same. Ventral view of the head and anterior appendages.

Figure 1b.—The same. Side view of head and anterior appendages.

Figure 1c.—The same. Side view of middle region of body.

Figure 1d.—The same. Posterior segments and caudal cirri, enlarged eight diameters.

Figure 1e.—The same. Transverse section of a segment.

Figure 1g.—The same. Setæ from the ventral fascicle, much enlarged: *v*, one with jointed and hooked tip; *v'*, one with jointed tip, acute at the end.

Figure 1s.—The same. A scale, enlarged.

Figure 2.—The same. Several forms of setæ from the ventral fascicle: *a*, *a'*, simple acute setæ, with partial whorls of spinules; *b*, one with short, hooked terminal piece, bidentate at tip and not distinctly jointed; *c*, *c'*, setæ with shorter and longer, jointed, acute tips.

Figure 3.—*Sthenelais picta* V. Dorsal view of head and anterior part of body, enlarged four diameters. From an alcoholic specimen.

Figure 3a, 3b.—The same. Dorsal and ventral views of the posterior segments and caudal cirri of a living specimen, much enlarged. Newport, low water, Aug. 8, 1880.

Figure 3c.—The same. A scale, enlarged.

Figure 3d.—Portion of the edge of the same scale, more enlarged.

Figure 4.—*Pholoë minuta*. Head and anterior segments, much enlarged. Newport, 1880.

Figure 4a, 4b.—The same. Scales, much enlarged.

Figure 4c.—The same. One of the parapodia, much enlarged.

Figure 5.—*Sigalion arenicola* V. Head and anterior segments, dorsal view. The scales of the first pair have been removed; enlarged eight diameters, from an alcoholic specimen.

Figure 5a.—The same. One of the scales, enlarged twenty-five diameters.

Figure 5b.—The same. One of branched appendages from the outer border of the scale, much enlarged.

Figure 5c.—The same. One of the parapodia, enlarged: *ds*, dorsal setæ; *a*, simple spinulated setæ of the ventral fascicle; *b*, *c*, different forms of compound setæ, with jointed, acute tips; *d*, *e*, compound setæ with bidentate hooked tips; *e'*, compound setæ with jointed tips, hooked at end; *v*, *v'*, different forms of capillary setæ in lower part of ventral fascicle, some with joints distally. Original specimens from Nantucket Sound, 1875.

Figure 5d.—The same. Some of the setæ more enlarged, lettered as in fig. 5c, enlarged 250 diameters.

Figure 6.—*Polynoe (Eunoe) spinulosa* V. Portion of the edge of one of the scales of the original specimen, from off Sable I., N. S., enlarged seventy-five diameters.

The drawings are mostly from preserved specimens, by J. H. Emerton. The appendages and setæ are camera-drawings from specimens mounted in glycerine-jelly.

#### PLATE VIII.

Figure 1.—*Travisia carnea* V. Dorsal view, enlarged nine diameters.

Figure 1a.—The same. Side view of one of the middle segments, more enlarged.

Figure 2.—*Arenicola marina* L. Side view, natural size.

Figure 3.—*Chitellio irrorata* V. Enlarged six diameters.

Figure 3a.—The same. One of the fascicles of setæ, much enlarged.

Drawn from life: figures 2-3a, by J. H. Emerton; 1, 1a, by J. H. Blake.

## PLATE IX.

Figure 1.—*Maldane elongata* V. Posterior segments and caudal appendage, side view, enlarged two diameters.

Figure 1a.—The same. Caudal appendage, end view.

Figure 2.—*Rhodine attenuata* V. Head and anterior segments, side view, enlarged six diameters.

Figure 3.—*Ophelia denticulata* V. Side view, enlarged one and one-half diameters.

Figure 4.—*Brada setosa* V. Dorsal view, enlarged three diameters.

Figure 5.—*Sculibrejma brevicauda* V. Dorsal view, enlarged four diameters.

Figure 5a.—The same. Head and anterior segments, enlarged eight diameters.

Figure 6.—*Urotulus cirratus*. Dorsal view, enlarged five diameters.

Figure 6a.—The same. Side view of head.

Drawn from living examples, by J. H. Emerton.

## PLATE X.

Figure 1.—*Nicolea simplex* V. Side view; the posterior segments are omitted, enlarged three diameters.

Figure 2.—*Amphitrite brunnea* Stimp., from Eastport, Me. Side view, enlarged two diameters.

Figure 3.—*Dodecacera concharum*. Enlarged five diameters.

Drawn from living specimens, by J. H. Emerton.

## PLATE XI.

Figure 1.—*Thelepus cincinnatus* V., from Eastport, Me. Side view, slightly enlarged, from life.

Figure 2.—*Pista cristata* Mgn. Side view of head and anterior segments, enlarged four diameters.

Figure 3.—*Scionopsis palmata* V. Side view, enlarged about three diameters, from life.

Figures 4 and 4a.—*Enoplobranchus sanguineus* V. Branchial parapodia of two segments, enlarged.

Figure 4b.—The same. Tip of one of the branchial divisions, with setae, much enlarged.

Figures 1 and 2 were drawn from living specimens, by J. H. Emerton; figure 3, from life, by J. H. Blake; figures 4–4b are camera-drawings from mounted specimens, by the author.

## PLATE XII.

Figure 1.—*Odontosyllis lucifera* V. Dorsal view of the head and anterior part of the body, much enlarged, seen as a transparent object, under a compressor; from a camera-drawing of a living specimen: *p*, pharynx; *g*, stomach or gizzard.

Figure 1a.—The same. One of the setae, greatly enlarged.

Figure 2.—*Pedophylax longiceps* V. Head and front part of body, and (a) caudal segments, ventral-view, much enlarged, from a camera-drawing of a living specimen.

Figure 3, 3a.—*Autolytus longigula* V., sp. nov. Dorsal view, from life, of a specimen taken at Newport, R. I. Head and anterior segments; 3a, caudal segments, enlarged about 20 diameters.

Figure 3b.—The same. Dorsal views, seen as a transparent object, under a compressor, to show the pharynx and stomach. Setæ, etc., are omitted.

Figure 4.—*Autolytus cornutus* A. Ag. Male, from life. Ventral view of the anterior part of body, and of the caudal segments (*a*), much enlarged.

Figure 5.—*Autolytus (Proceræa) ornatus* V. (?). Male, from Wood's Holl, Mass. Dorsal view, from life, of the anterior and posterior (*a*) portions, more enlarged than fig. 4.

Figure 6.—*Autolytus cornutus*. Female. Ventral view of the head and anterior segments, including the first segment bearing long, capillary, sexual setæ, enlarged 14 diameters.

Figure 7.—*Autolytus varians* V., nom. nov., p. 320. Female. Dorsal view of the anterior segments, including three of those bearing sexual setæ, enlarged.

Figure 8.—*Autolytus Alexandri* Malmgren. Male. Dorsal view, enlarged 14 diameters. Specimen from Salem, Mass., in alcohol, taken in early spring: *a*, median, odd antenna; *a'*, pair of small frontal antennæ; *a''*, large forked palpi, or antennæ, characteristic of the male, in this genus; *tc*, upper and lower tentacular cirri, arising from the concealed buccal segment; *dc'*, large dorsal cirri, arising from the first body-segment (1), which, in this species, bears a fascicle of setæ, beneath (see fig. 8a); *dc*, dorsal cirri of segments 2 to 15; *s*, short setæ of the 14 anterior segments; *s'*, long sexual setæ, beginning on the 15th segment.

This may be the sexual form of *Stephanosyllis ornata* V.

Figure 8a.—The same. Ventral view, including only the head and 14 anterior segments. Lettering the same as in fig. 8.

Figure 8b.—The same. Female. Dorsal view, including the 14 anterior segments, enlarged 14 diameters. From Salem, Mass. Lettering as in fig. 8, but with the following additions: *e*, "epaulets" or lobes extending back from the head; *vc*, ventral tentacular cirrus; *a''*, the pair of long simple frontal antennæ.

Figure 8c.—The same. One of the short, compound setæ, with bidentate tip, from a short anterior segment. Greatly enlarged.

Figure 9.—*Autolytus Emertonii* V., sp. nov. Male. Dorsal view of the head. Enlarged 14 diameters. From an alcoholic specimen, taken at Salem, Mass., at the surface, in February, by J. H. Emerton. Lettering as in figs. 8, 8a.

Figure 9a.—The same. Male. Ventral view, showing the very large dorsal tentacular cirrus (*tc*) and the smaller ventral one (*vc*); the six anterior setigerous segments have short and nearly equal dorsal cirri, the first pair being the smallest and crowded beneath the large tentacular cirri.

Figure 9b.—The same. Female. Ventral view of a specimen from Salem, Mass., in alcohol, enlarged 14 diameters. Lettering as in 8b.

Figure 9c.—The same. Peculiar setæ of the short anterior segments.

Figure 10.—*Autolytus longisetosus*. Male. Dorsal view of the anterior part of a large alcoholic specimen from Salem, Mass., taken in February by J. H. Emerton, enlarged 14 diameters. Lettering as in figs. 8 and 8a.

Figure 10a.—The same. Male. Ventral view of the head and anterior segments. The ends of some of the appendages are omitted.

Figure 10c.—The same. One of the compound setæ of the anterior segments, greatly enlarged.

Figures 1 and 5 are by J. H. Blake; 2 and 7 by the author; the rest by J. H. Emerton.



IX.—THE NORTH AMERICAN SPECIES OF CONOPS. BY S. W.  
WILLISTON, M.A., M.D.

OF the fourteen species of *Conops* recorded in Baron Osten-Sacken's valuable catalogue of North American Diptera, but four are designated by the author as having been recognized, viz: *excisus* Wied., *genualis* Loew, *pictus* Fab., and *sagittarius* Say. As to the last, it is, however, most probable that the species really recognized was *tibialis* Say, our most common one, and which had been confounded by both Wiedemann and Loew, and re-described by both as *nigricornis* Wied., the real *sagittarius* being possibly described anew as *genualis* Loew, which I believe to be its synonym. *C. pictus* is unknown to me; its recognition must depend upon that of its synonym, *Ramondi* Bigot (teste Loew, vide Osten-Sacken's Catalogue), as the original description of Fabricius is wholly insufficient. In the present paper all of the recognizable descriptions, whose habitats are creditably referred to North America, have been determined with sufficient certainty, except *genualis* Lw., and *castanopterus* Lw., both of which I believe to be of doubtful value. *C. æthiops* Walker has been recognized with as much certainty as most of the descriptions of that author will admit of, while none of Macquart's very insufficiently described species have been recognized, nor the South American species identified by him as also pertaining to North America. ? *Conops quadrimaculatus* Ashmead, is a syrphid, probably a *Bacha*.

The material herein described has been wholly derived from Mr. Burgess, to whom my sincerest thanks are due, and my own collections. Although by no means so large as I desired, it is, I trust, sufficient to remove many of the obstacles to the future study of our species. The indiscriminate description of new species, without a considerable knowledge of allied species, is here especially to be deprecated; and, owing to the great individual variation of color, and the paucity of plastic characters, large collections will be essential, eventually, to a complete and satisfactory knowledge.



My knowledge of such variations I have endeavored to supplement by the study of the descriptions of foreign species, and I deem it worth the while to here give a translation of Dr. Loew's very pertinent remarks upon the value of the specific characters in this genus.

"Those specific characters have the greatest weight here, as elsewhere, that are based upon the differences in form; such are not always easy to find, yet the shape of the antennæ and antennal style, the structure of the face, the length of the proboscis, the structure of the abdomen and of the legs, and finally the neurulation offers many good characters. Next in value to these characters are those derived from the yellow or white shimmering markings of the dorsum of the thorax, the pleuræ and the metanotum; so, also, from the form and boundaries of the coloration of the wings, when such is present. The presence or absence of yellow spots on the sides of the metanotum, and the color of the scutellum are also good characters. Finally, the color of the front is quite useful, when cautiously employed, as it is rather changeable in many species. Much less dependence is to be placed upon the characters derived from the dust-markings of the abdomen; least of all upon the coloring of the body in those species that are black and reddish brown, as sometimes they may be quite black, sometimes reddish brown, with more or less black, or sometimes indeed quite ferruginous." (Neue Beitr., i, p. 20.)

The following table of the American genera of Conopidæ, adapted from Schiner, with the aid of a considerable number of our own species, will be of service to many:

Third antennal joint with a terminal style; ocelli wanting.	<i>Conops</i> Linn.
Third antennal joint with a dorsal, or sub-dorsal bristle:	
Proboscis bent only at the base.	<i>Zodion</i> Lat.
Proboscis bent at base and near the middle, the anterior part closely folding back:	
Anal cell, short, obtuse:	
Bristle of antennæ dorsal, proboscis not of unusual length.	<i>Dalmannia</i> Rob.
	[Des.
Bristle of antennæ near the end of third joint (sub-dorsal), proboscis very long, abdomen cylindrical.	<i>Stylogaster</i> Mac.
Anal cell, extending well toward the border of the wing, acute:	
Face much produced, inferiorly, the cheeks broader than the vertical diameter of the eyes, abdomen depressed, short.	<i>Myopa</i> Fab.
Face moderately produced inferiorly, cheeks not broader than the vertical diameter of the eyes; abdomen mostly cylindrical and moderately long.	<i>Oncomyia</i>
	[Rob. Des.

Schiner has divided the genus *Conops*, upon what appears to me insufficient grounds.\* I have retained all our American species under the genus in its wider sense.

In the following table I have not attempted to include the species of Macquart, nor his identifications. I have added the original descriptions at the close of the article, although there is very little possibility of their ever being recognized. *C. pictus* F. is also not included in the table, but its description is given :

**A.**—Small cross-vein nearly opposite or before the tip of the costal vein and near the middle of the discal cell. **a.**

**B.**—Small cross-vein beyond the tip of costal vein and near the outer third of discal cell; third joint of antennæ much shorter than the second. **e.**

**a.**—Third joint of antennæ much shorter than the second. Face and cheeks yellow; facial grooves not darkened; front wholly black; wings brownish before, subhyaline behind, picture indistinct. *obscuripennis*, n. sp.

—Third joint of antennæ nearly or quite as long as second, brown of anterior portion of wings with distinct outlines. **b.**

**b.**—Attenuated portion of antennal style very short, head comparatively narrow, proboscis very short, a hyaline crossband before the tip of the wing. Shining black, dust grayish, front blackish or black. *syllvosus*, n. sp.

—Attenuated portion of style quite long; proboscis considerably longer than the head; the brown reaches the whole length of the wing. **c.**

**c.**—Stripe of dust on upper half of pleura indistinct or without distinct borders. Front black, cheeks brown behind; proboscis about once and a half the length of head. (Dark colored species.) *bulbirostris* Lw.

—Stripe of dust on upper half of pleura as sharply defined as on the under half. **d.**

**d.**—Proboscis twice the length of head, stripe on upper half of pleura narrow. Dust on the sides of mentanotum much narrowed toward the disk; front mostly red, darkest above base of antennæ. (Reddish species.) *excisus* Wied.

—Proboscis scarcely once and a half the length of head, much swollen at the base; pleural stripe broad above. Dust broadly

\* Schiner's characters are as follows:

Schenkel nicht verdickt, wenn sie aber verdickt sind, dann ist die Verdickung an der Basis nicht auffallend, sondern von da bis zur Spitze ein regelmässige; zweiter Hinterleibsring nicht auffallend schmaler und länger als die übrigen Ringe.—*Conops* Lin.

Schenkel an der basis plötzlich und in auffallender Weise verdickt, so dass die Verdickung immer unregelmässig erscheint; zweiter Hinterleibsring auffallend schmaler und länger als die übrigen Ringe. *Physocephala* Sch.

covering the sides of metanotum; front mostly yellow; face, cheeks, and under part of occiput yellow; facial grooves with a black spot on each side of middle. *xanthopareus*, n. sp.

**e.**—The brown of the wings fills out the discal cell to beyond the great cross-vein. **f.**

—Outer portion of discal cell from near the small cross-vein distinctly lighter or hyaline. **g.**

**f.**—Cheeks uniformly black; dust on the humeri indistinct; posterior orbits with a very narrow whitish line. (Black species.)

*tibialis* Say.

—“Cheeks brownish yellow; posterior orbit with yellowish brown border; humeri dusted with golden yellow.” *genualis* Lw.

—Cheeks with a yellow spot in the middle, brown in front and behind; humeri with distinct yellow dust. { *sagittarius* Say.

{ *castanopterus* Lw.

**g.**—Cheeks uniformly black or brown; basal joint of antennæ very short. **h.**

—Cheeks with a yellow spot in the middle; first joint of antennæ but little or not at all shorter than the third. **i.**

**h**—Front with deep black transverse and median divaricate stripes. (Dark-colored species.) *furcillatus*, n. sp.

—Front with very narrow reddish stripes or wholly yellow; dorsum of thorax with a broad, median, posteriorly abbreviated, black stripe. (Reddish species.) *Burgessi*, n. sp.

**i.**—Ultimate segment of fourth vein nearly twice as long as the penultimate; dorsum of thorax with a narrow, median, black stripe. (Reddish species.) *texanus*, n. sp.

—Ultimate segment of fourth vein but little or not at all longer than penultimate. **k.**

**k.**—Facial grooves and frontal stripes black. (Dark-colored species.) *marginatus* Say.

—Facial grooves but little or not at all darkened; frontal stripes nearly or quite obsolete; dorsum of thorax with three black stripes, narrowly separated or confluent, the median one more abbreviated behind. *affinis*, n. sp.

### *Conops obscuripennis*, n. sp.

♂. Face and cheeks yellow, facial grooves not darkened; near the orbits a rather broad, glistening, yellow border, extending as a line to the vertex. Proboscis nearly black, about as long as the antennæ, much swollen at the base. Antennæ nearly black, first and third joints reddish below, of nearly equal length, scarcely more than one-half as long as second joint; second joint of style moderately projecting; third joint gradually tapering, of medium length. Front wholly black; with a coppery luster, when viewed obliquely. Occiput black, with a rather narrow golden yellow border along the orbit. Thorax black; spots on the inner sides of the humeri, the

upper border of the disk of the metanotum, and large spots in front of the halteres nearly golden yellow, a small spot below each humerus, and one above the root of the wing, less distinct, of the same color. Upper portion of pleural stripe not distinctly defined. Abdomen black, second segment mostly brownish, its tip, and beginning of the third, pure yellow; first and second segments narrowly, or indistinctly, dusted; third, fourth and fifth with moderately broad yellow hind borders; sixth segment covered on the end with yellowish dust. Legs brown or black; base and tips of femora and basal portions of tibiæ, yellow. Coxæ and anterior tibiæ on their outer portions with a more golden satiny luster. Wings darker before the third longitudinal vein, sub-hyaline behind; the darker portion nowhere with distinct outlines, a little clearer nearer the humeral cross-vein; slightly darker, narrow clouds before the fifth and sixth veins. Posterior cross-vein at right angles. Long. corp., 8–10<sup>mm</sup>. Five specimens, Va. (Davis); S. Ca., Ga. (Morrison); Mass. (Burgess).

*Conops sylvosus*, n. sp.

♂. Face obscure white, or yellow, with a broad border of silvery dust near the orbit, extending, obliquely narrowed, to near the vertex; facial grooves not darkened. Cheeks like the face, oral border sharp. Front obscurely, or quite black, extending down on the sides of the base of the antennæ. Vertical callosity black, or reddish-black, flattened, extending far forward. Antennæ black, red on the under sides, third joint as long as second, first joint more than half as long. Second joint of style projecting very little, third joint rather short, with a very brief bristle-like end. Proboscis brownish black, scarcely as long as the two last joints of the antennæ. Occiput black; orbits, except on the upper part bordered with yellowish dust. Thorax black, shining; inner sides of humeri, disk and sides of metanotum, faintly dusted with white. Abdomen black, shining; sides of the second segment more or less red. All the segments, except the sixth, with nearly uniform, rather narrow, yellowish white hind borders; fifth, and especially the sixth, dusted with whitish. Legs black; coxæ, particularly the first pair in front, and a small spot near the tip of each of the anterior tibiæ, with satiny white luster. Extreme base and tips of femora, red or yellow; basal three-fifths of anterior, and two-fifths of hind tibiæ, light yellow; distal portions and tarsi, reddish brown. Wings light brown and pure hyaline, costal cell scarcely lighter; the brown is limited by the third longitudinal

vein as far as the small cross-vein; then by the fourth longitudinal to the great cross-vein, beyond which is a hyaline cross-band reaching the costal margin, excepting sometimes a faint, narrow cloud along the third vein. A brown spot in the end of the submarginal cell that extends a short distance on the posterior side of the third vein; great cross-vein and the anterior side of the fifth vein from near the small cross-vein, with brownish clouds. Great cross-vein not at all oblique. Long. corp., 9–11<sup>mm</sup>; Long. al., 6–7½<sup>mm</sup>. Three specimens. On underbrush, Mass., July 1; Conn., June 25. New England (Sanborn); Burgess' col.

The hairs on the vertex, dorsum of thorax and sides of first abdominal segment, are longer and more abundant than in any other species known to me. Its parasitic habits will probably be found to be quite different from any of the following.

### *Conops excisus* Wied.

Aus. Zw. ii, 234. Lw., Neue Beitr., i, 28.

♂. Face yellow, the orbits with a rather broad glistening border of yellowish white, extending as a narrow line nearly to the vertex; facial grooves not darkened; cheeks more reddish. Proboscis about twice the length of the head; reddish brown; at base and tip black. Antennæ red or reddish brown, more or less black near the end of the third joint; first joint more than half as long as second, second and third of equal length; second joint of style with a very inconspicuous process; third joint at the base not very broad, and soon attenuated into a long, bristle-like point. Vertex red or reddish brown; front mostly filled out with dark, reddish brown, blackish above the base of the antennæ. Occiput brown, orbits with a line of yellowish dust, broader above and extending across below the vertex. Thorax black; humeri, scutellum, and the upper parts of the sides of the metanotum, red. The lateral borders of dorsum may be of the same color. Humeri on their inner sides and extending outwards along their hind border; a small spot in front below; another in front of the roots of the wings above; narrow pleural stripes, distinctly margined above; upper margin of the metanotum; and a large spot in front of each halter, bright golden yellow. Smaller spots on the sides of the disk of the metanotum and just back of the root of the wings, more grayish yellow. Abdomen chiefly black; second segment on its sides or almost wholly, red; the three or four following segments with only the hind border, red, or also with large

spots on the sides. Hind borders of the segments with bright golden yellow bands, broad on the second, narrower on the third and fourth, and broad again on the fifth; sixth segment behind, similarly colored. Anterior parts of second, fifth, and sixth segments more grayish dusted. Legs red; base of tibiae yellow, anterior pairs on the outside with white luster; tarsi brownish black, first joint reddish black. Wings rather dark brown and hyaline, distinctly clearer before the first longitudinal vein. From the small cross-vein the discal cell, except a dark brown cloud before the fifth vein, is nearly hyaline, limited in front by a very clear streak between the fourth vein and a sort of spurious vein, extending between the anterior ends of the small cross-vein nearly to the posterior; last segment of the fourth vein with a rather narrow clearer space in front. Sixth vein with a dark brown cloud. Long. corp., 13–16<sup>mm</sup>. Long. al., 10–11<sup>mm</sup>. Ga., Flor., N. Carolina (Morrison).

The female, according to Loew, has an unusually large process on the underside of the fifth segment. The red color on the sides of the segments is not a sexual marking.

### *Conops bulbirostris* Loew.

Neue Beitr., i, p. 30.

Very closely allied to the foregoing, yet evidently distinct. A single female specimen was described by Loew which agrees nearly perfectly with two male specimens before me, from Carolina and Georgia. (Burgess' collection.)

The second joint of the antennae is proportionately a little longer, but I can see no difference in the length of the terminal joint of the style; the proboscis, however, is distinctly shorter, and at its base more swollen. The second segment of the male abdomen, in my specimens, at least, is narrower.

♂. Front wholly and quite black, vertex a more brownish black, face yellow, cheeks brown, the brown not reaching far forward. Antennae black, somewhat reddish on the undersides of the first and third joints. Thorax and abdomen black throughout. The grayish or grayish yellow, and much less distinct dust markings of the head and thorax are quite as in *excisus*, except that the spot on the side of the dorsum of the thorax, before the root of the wing, is less distinct, the dust on the disk of the metanotum broader and less sharply defined, and the pleural stripe is indistinct or diffused on the upper half. The third and fifth segments of the abdomen have rather narrow, the

fourth very narrow, gray or slightly yellowish hind borders; sixth segment, on the end, thickly dusted with gray, yellowish at the tip. Legs reddish brown (or "brownish black," Loew), marked quite as in *excisus*. Color of wings rather darker than in *excisus*, especially before the first vein; the first and second basal cells near the fourth vein are lighter or with hyaline streaks; otherwise scarcely at all different. "Of the size of medium specimens, and the shape fully as in *excisus*" (13-14<sup>mm</sup>), Loew. The specimens before me measure 16-17<sup>mm</sup>.

An additional female specimen from Georgia has the antennæ and proboscis nearly as in *excisus*, but its coloration and markings similar to *bulbirostris*; the process of the fifth abdominal segment, below, is of extraordinary size. It measures but 9<sup>mm</sup>. I believe it to be distinct.

#### *Conops xanthopareus*, n. sp.

♂ ♀. Face and cheeks yellow, with glistening dust near the orbits, extending narrowly upon the sides of the front. Facial grooves with a black spot on each side of the median prominence; proboscis reddish brown, black at the ends; base much swollen, scarcely once and a half the length of the head. Antennæ reddish brown, considerably blackened at the end of the third joint; first joint more than half as long as second; second and third of equal length; process of second joint of style small, but more projecting than in the two preceding; third joint moderately long, the attenuated portion scarcely as long as its basal portion. Front and vertex yellow, brownish above the base of the antennæ. Occiput brown, its under part pure yellow. Posterior orbits with borders of grayish yellow dust. Thorax black, humeri and more or less of the scutellum red. A spot on the inner side of each humerus, a small spot below; broad pleural stripes, distinctly limited above; upper border of disk of metanotum, extending broadly on its sides, golden or grayish yellow. Abdomen mostly black, sometimes quite reddish upon the sides, especially of the second segment; the four anterior segments rather broadly bordered with golden or grayish yellow, nearly the whole upper surface of the fifth and sixth segments thickly dusted with the same; process of the fifth segment of the female rather small below. Legs red, basal half of tibiæ yellow. Coxæ and outer distal part of anterior tibiæ with silvery luster; tarsi brownish black, last four joints, quite black. Wings brown in front, subhyaline be-

hind, a stripe in the first basal cell, and the base of the anal cell, pure hyaline. The subhyaline fills out a larger part of the discal and first posterior cells; the stripes along the fifth and sixth veins not so well marked as in *excisus*, otherwise similar. Long. corp., 11-12<sup>mm</sup>, long. al., 10<sup>mm</sup>. Four specimens, Texas (Belfrage); Mass., Conn.

Two additional male specimens from Connecticut, differ in their much deeper black, the legs in part, the antennæ almost wholly so, the spot above the base of the antennæ larger, the humeri and scutellum scarcely reddened, and the dust markings throughout are more gray.

### *Conops tibialis* Say.

Journal Acad. Phil., vi, 171.

*C. nigricornis* Wied., Aus. Zw. Ins., ii, 236, 4. Loew, Neue Beitr., i, p. 31.

♂ ♀. Face waxy yellow; cheeks black, with a narrow silvery line near the orbit; facial grooves deep black. Proboscis black, considerably swollen at the base. Antennæ black; the under sides of the first and third joints somewhat reddish brown; first and third joints of nearly equal length, scarcely half as long as the second; process of second joint of style only moderately projecting; third joint conic, rather short. Vertical callosity nearly black, rather shining, bordered in front by a black, opaque, transverse stripe, continued as a median stripe to near the base of the antennæ, where it divaricates A-like on to the sides of the face. Occiput black, dusted with whitish, above posterior orbits with a narrow white line. Thorax deep black, with whitish bloom when viewed obliquely; humeri usually concolorous, sometimes slightly tinged with red, faintly or not at all dusted with white above; sides of metanotum inconspicuously dusted with white. Abdomen black, first and second segments with broader, remaining segments with narrower, posterior yellowish white borders, fourth, fifth, and sixth with white dust above, becoming most abundant on the sixth. Legs black, coxæ with satiny white luster; trochanters, base and extreme tips of femora, yellowish red; basal halves of tibiæ yellow, distal portions reddish brown; anterior pairs, on their outer distal portions with satiny white luster. Tarsi: anterior pairs reddish, becoming black at tips, hind pair mostly black. Anterior half of the wings dark brown, before the first longitudinal vein not much clearer; the brown accompanies the fifth longitudinal vein nearly to the border of the wing, then follows



parallel to the great cross-vein till it reaches the last segment of the fourth, which it accompanies to near the tip, and then borders the last segment of the third longitudinal in the second posterior cell; sixth longitudinal vein with a dark brown stripe in front. Posterior cross-vein but slightly oblique; third and fourth longitudinal veins distinctly angulated at the tips of the small cross-vein. Long. corp., 11–13<sup>mm</sup>. Long. al., 9–10<sup>mm</sup>. Thirty specimens. Indiana (Say); Mass., Conn., D. C., Va., N. C.

Our most common eastern species, and very uniform in its markings. Of the synonymy, there can be no doubt. Loew's description of the first and third joints of the antennæ being about *one-third* as long as the second, I can attribute only to an error, as in neither this nor *sagittarius* is the discrepancy nearly so great. The differences between *tibialis* and *sagittarius* are such that Wiedemann's supposition of the synonymy, drawn from Say's brief description, is quite excusable and fully accounts for his doubts in giving a new name. The description of *tibialis* by Say appeared but a short time previous to Wiedemann's second volume of his *Zweiflügelige Insecten*, and was also apparently overlooked by Loew. The two species are most readily separated by the color of the cheeks, a character which I have found of excellent value in all the specimens of the genus examined by me.

Two female specimens from Georgia (Morrison), and Texas (Bel-frage), in Mr. Burgess' collection, differ in their much larger size (16<sup>mm</sup>), and deeper black color throughout, yet they are evidently the same.

*Conops sagittarius* Say (*non* Wied., Loew).

Journ. Acad. Phil., iii, 83, 2.

? *C. genualis* Loew, Neue Beitr., i, p. 32.

? *C. castanopterus* Loew, loc. cit.

♂ ♀. Face waxy yellow; cheeks behind and a transverse spot in front, reddish brown, or brownish black, enclosing a quadrate yellow space; a white line near the orbits, not extending higher than the antennæ. Facial grooves black, lighter in the median line. Proboscis reddish brown, black at the end, considerably swollen at the base. Antennæ red, or reddish brown, deeper on the upper sides of the joints, first and third joints of nearly equal length, scarcely half as long as the second; process of second joint of style a little more prominent, and third joint more acuminate than in *tibialis*. Vertex varying from red to brownish black, bordered in

front by a black, opaque, transverse stripe, continued as a median stripe to its divarication, near the base of the antennæ. Occiput black, dusted with white, posterior orbit with a moderately broad yellowish white line. Thorax black, with whitish bloom, scutellum wholly or in part red; humeri red or reddish yellow, with a very conspicuous spot of golden yellow dust above, continued on their inner sides, and less conspicuously behind; the narrow, and on the upper half indistinctly limited oblique stripes of the pleuræ, upper border of the disk of the metanotum and large spots on the sides with yellowish gray dust. Abdomen black, more or less red near the tip of second segment; first segment with white, end of second with yellowish dust; hind borders of third, fourth, and fifth segments conspicuously golden yellow, broadest on the fourth; fourth, fifth and sixth segments conspicuously dusted with white or yellowish. Legs red or reddish brown, often quite black on basal half of femora, behind; basal halves of tibiæ yellow, anterior pairs in their distal portions with a satiny white luster, like the coxæ; tarsi black near the tips. Anterior half of wings brown, the markings quite as in *tibialis*, a small subhyaline space more frequent in the first posterior cell. Long. corp., 11–13<sup>mm</sup>. Long. al., 8–10<sup>mm</sup>. Seven specimens, Penn. (Say). Mass. Conn.; N. Carolina (Morrison).

Loew's description of *genualis* agrees very well, throughout, except that the cheeks are *brownish yellow*. *C. castanopterus* agrees in some respects even better. I give here careful translations of both descriptions, as they are rather inaccessible.

### Conops genualis Loew.

Neue Beitr., etc., i, p. 32.

♂ ♀ "Face yellow; facial grooves black, the cheeks brownish yellow, without luster except on the under half of the orbit, where there is a white line. Front on the sides yellow with a narrow median black line, bifarious above the antennæ and passing as a black line upon each side of the face. Vertical callosity yellowish brown, bordered in front by a narrow black transverse band. Occiput blackish brown, posterior orbit with a border of yellowish brown dust, below yellow. Antennæ dark brown, below nearly ferruginous; first joint about half as long as the second; the third at the end attenuated; second joint of the style moderately large, strongly projecting, the third short. Thorax black, humeri and scutellum blackish brown, the former with nearly golden yellow

dust above which extends inwards on the front border of the thorax and behind nearly to the roots of the wings; pleuræ with an indistinct white stripe; metanotum above and the two spots on the sides with grayish yellow dust. Abdomen quite black, the first and second segments with rather narrow bands of yellowish dust; on the third segment only a finely yellowish dusted posterior line; the fourth and fifth segments of the male abdomen with a similarly dusted somewhat broader posterior border; the fifth segment with a very narrow posterior line; the last two segments in both sexes with yellow dust. The extension of the fifth segment below in the female as in [*tibialis*], but the last segment somewhat shorter. The coloration of the wing and the neurulation wholly as in my specimen of [*tibialis*]. Length of body as in [*tibialis*]."

**C. castanopterus** Loew.

Neue Beitr., i, 33.

"A third species further removed from [*tibialis*] but more nearly related to *genualis*. It is most readily distinguished by the more blackish brown color of the anterior part of the wings, which is distinctly clearer before the first longitudinal vein, by the ferruginous color of the humeri, the lateral margins of the thorax, the scutellum, and a larger or smaller, sometimes a very large part of the abdominal segments and the legs. The third joint of the antennæ is at the end yet more attenuated; on the cheeks a large yellow spot lies between the brown. In all else quite as in *genualis*. Georgia, Carolina."

**Conops fuscillatus**, n. sp.

? *C. æthiops* Wlk., List., etc., iii, 671.

♂ ♀. Face waxy yellow, facial grooves not darkened, cheeks black. Proboscis black, not much swollen at the base. Vertical callosity black, bordered in front with opaque black, extending as a median stripe to the antennæ and there divaricating and passing as a black line upon each side of the face. Antennæ brownish black, first and third joints more reddish below, first joint very short, scarcely a third as long as second, third joint about half as long; third joint of style short, conical. Occiput black, broadly dusted with whitish below the vertex. Dorsum of thorax black, more or less reddened near the borders; humeri with a spot of yellowish white dust on their

inner sides. Scutellum more or less reddish, the usual spots on the metanotum indistinctly dusted. Pleuræ chiefly reddish, especially along the sutures, the disks of the segments sometimes mostly blackish. Abdomen black, the second segment, on its sides, and sometimes the beginning of the third, reddish brown; first segment with distinct, second with broader, especially on the sides, third and fourth with moderately broad, fifth with narrower borders of grayish yellow dust; posterior part of fourth, with the fifth and sixth distinctly whitened above. Legs reddish or reddish brown; fore and hind coxæ darker, with satiny luster; femora sometimes darker toward the base, basal halves of all the tibiæ yellow, tips of all the tarsi dark brown or black. Wings brown on the anterior half, lighter before the first longitudinal vein; from a little before the small cross-vein the discal cell is hyaline, excepting a narrow dark cloud before the fourth longitudinal vein, reaching nearly or quite to the great cross-vein; on the anterior side of the fourth vein an oval longitudinal space in the first posterior cell, reaching nearly the whole length of the segment of the vein, a lighter spot in the outer part of the submarginal cell, near the margin. Petiole of the first posterior cell about as long as the posterior cross-vein. Long. corp., 10–12<sup>mm</sup>, long. al., 7–9<sup>mm</sup>. White Mts. (Patton, Morrison). Three specimens.

The very short first joint of the antennæ renders it probable that this is Walker's *æthiops*, but his very indefinite description of the front and wings prevents me from feeling at all sure of it.

### *Conops Burgessii*, n. sp.

♂ ♀. Face and front yellow, vertex concolorous or reddish, when the latter, with a more or less faint narrow median stripe, scarcely reaching the base of the antennæ. Facial grooves not distinctly darkened, cheeks red. Proboscis brownish red, black at tip. Antennæ red; first joint very short, scarcely a third the length of second; third joint a little more than half as long as second, rather symmetrically attenuated. Style black, process of second joint small, not conspicuous, third joint not thickened, moderately long, conical. Occiput red, not distinctly dusted. Thorax red; a broad, median, posteriorly abbreviated stripe, spots in front of the humeri and disk of metanotum, except the sides and upper edge, black. No, unless very indistinct, spots of dust near the humeri, nor elsewhere on the thorax. Abdomen red, sometimes somewhat blackish on the sides of the segments, especially of the third; faint spots of dust on the first and near the tip of

second segment, posterior segments very faintly dusted on their upper sides. Process of fifth segment below, in the female, not large. Legs red, anterior coxæ blackened in front, without distinct luster. Coloration of wings as in the preceding species, the cloud along the fifth vein in the outer part of discal cell, often quite obsolete, scarcely any along the sixth. Long. corp., 10–11<sup>mm</sup>, Colorado (Prof. Snow); Mendocino, Cal. (O. T. Baron). 16 specimens.

*Conops texanus*, n. sp.

♂. Face and front yellow, anterior border of the vertical callosity a little darker, a narrow median stripe, divaricate at base of antennæ, brown; facial grooves not darkened. Cheeks with a transverse brown spot in front, continued as a narrow line along the oral border to the brown of the posterior part. Antennæ red, a little darker at the tip of third joint, third joint short, hardly as long as first, distinctly less than half the length of second; second joint of style projecting strongly, nearly as far as third, third short, conic. Proboscis red, base and tip blackish. Occiput brownish below, posterior orbit with a yellowish white border, broader above, continued as a narrow line behind the eye, and broader on the sides of the face. Dorsum of thorax, pleuræ, and scutellum red, humeri lighter, a narrow median dorsal stripe and triangular spot on the disk of metanotum, black; humeri above, a spot on the inner side and behind, with yellow dust, oblique stripe of the pleuræ (diffused on the upper half), upper border of disk and sides of metanotum with fainter, less yellow dust. Abdomen brownish red, with more or less black on upper parts of the segments, first segment distinctly, the others more faintly, dusted. Coxæ usually black, satiny luster distinct, but not conspicuous. Legs red, basal halves of tibiæ yellow. Wings brown and hyaline; costal cell much lighter, nearly hyaline. Discal cell from before the small cross-vein, except a cloud along the fifth vein, and an oval spot in first posterior cell, nearly hyaline. The penultimate segment of the fourth vein is scarcely three-fifths the length of the ultimate. Long. corp., 16<sup>mm</sup>, long, al., 10<sup>mm</sup>. One specimen. Waco, Texas (Belfrage, Burgess' col).

*Conops marginatus* Say.

Journ. Acad. Phil., iii, 82, 1. Comp. W., ii, 73.

♂. Face and front waxy yellow, vertex rather brownish black, with a broad opaque black anterior border, extended as a narrow

median stripe to the base of the antennæ, there divaricating and passing to the sides of the face; facial grooves black, cheeks with a yellow space between two black ones. Proboscis black. Antennæ black, first and third joints, below, red, of nearly equal length, scarcely half the length of second, third joint quite unsymmetrically attenuated, about half as broad at base as long, second joint of style with a considerably projecting, rather slender process, third joint moderately long, conical. Occiput black, posterior orbits with a narrow silvery line. Thorax black, scutellum red. Humeri above and on the inner sides with silvery white dust, sides of the metanotum and the oblique stripe of the pleuræ (indistinct in its upper part) with white dust. Abdomen black, second segment reddened on the sides near the tip, hind borders of all the segments with yellowish dust, rather broadest on the fourth, fifth and sixth lightly dusted with gray above. Legs brownish red, probably often quite blackish, especially near the base of the femur; coxæ black with silvery luster. Wings brown on anterior half. Costal cell lighter, outer part of discal cell hyaline, except a narrow cloud along the fifth longitudinal vein; a more or less large spot in first posterior, hyaline, outer part of marginal cell less deeply colored. Sixth longitudinal vein without brown cloud. Long. corp., 10–11<sup>mm</sup>. Long. al., 6–7<sup>mm</sup>. Two specimens. White Mts.

*Conops affinis*, n. sp.

♂ ♀. Front either wholly yellow, or with the vertex rather more reddish, and with a brownish anterior border extending as a narrow median stripe to the base of the antennæ and there divaricating. Face yellow, grooves usually quite the same, sometimes a little reddish near the middle. Cheeks with a yellow spot between the brown. Proboscis red, tip black. Antennæ yellowish red, third joint more or less infuscated above. The relation of the joints very nearly as in *marginatus*; the process of the second joint of style is, however, broader, and the third joint shorter and thicker. Occiput brown, posterior orbits with a narrow yellowish line. Thorax red, dorsum with a broad, median, opaque black stripe beginning at the neck and extending beyond the transverse suture, either very narrowly separated or confluent on each with a similar one beginning back of the humerus and extending to near the scutellum. Disk of the metanotum, except the edges, black. Humeri above, a spot on the inner side, a faint one behind, with golden yellow, or in lighter colored specimens grayish dust. Oblique stripes of the pleuræ and sides of the metanotum very

faintly dusted. Abdomen red, with more or less black, on the dorsum of the third, fourth and anterior part of fifth segments; posterior part of fourth, the fifth and sixth segments, in well preserved specimens, quite conspicuously dusted with golden yellow. Legs red, coxæ mostly, or at least the middle ones in front, black; basal half of tibiæ yellowish. Wings light brown on the anterior half, coloration very nearly as in the preceding, the first posterior cell, sometimes scarcely at all, sometimes for the larger part, nearly hyaline. Long. corp., 10–11<sup>mm</sup>. Twelve specimens. Kansas Plains; California (Baron); Washington Ter. (Morrison).

This species is intermediate between *marginatus* and *texanus*, holding the same relation to the former as *Burgessi* does to *furcillatus*. From *texanus* it may be distinguished by its much smaller size and broad thoracic stripes, from *marginatus* by the shape of its antennal style and the strong difference in coloration.

### *Conops pictus* Fab.

According to Loew, who apparently has recognized this species, (Vide O. Sacken's Catalogue, Note 258), *pictus* F. is not *pictus* Wied. but *Ramondi* Bigot is a synonym of the former. Not having seen the species I give here Fabricius' original description, together with Bigot's:

Fab. Ent. Syst. IV, 391, 3. Caput ferrugineum, rostro nigro orbitaque oculorum aurea. Thorax niger antice utrinque puncto calloso, marginali ferrugineo. Lineolæ duæ parvæ marginis antici, lineæ lateralis, scutellum lineaque punctaque duo sub scutello flavis. Abdomen hamosum, ferrugineum segmenti primo et secunda nigris margine flavo. Alæ hyalinae, costa late flava. Pedes ferruginei, apice nigri.

*C. Ramondi* Bigot, Ramon de la Sagra, 808.

"Niger, capite ferrugineo; oculis brunneis; antennis ferrugineo-brunneis, basi pallidis; haustello ferrugineo, acumine brunneo; facie ferruginea, aureo-nitente; fronte ferrugineo, lineæ media brunnea; orbitis, postice, flavidis; thorace nigro-piceo, antice, lineæ transversali sinuata, interrupta, flava; metathorace postice subtus lineæ lata transversali, flava; pleuris externe auratis; alis hyalinis, antice margina ferruginea; margine magna apicali fusca; abdomine petiolato, segmentis duobus primis nigris, incisuris pallide flavis; omnibus segmentis posterioribus rubescentibus; incisuris superne obscure brun-

neis; pedibus, antice, ferrugineis, postice, pallide auratis; tarsis nigricantibus; pulvillis ferrugineis.—Longit. 23 millim.

"Esta bella especie parece casi idéntica al *C. picta* de Fabr. (*Syst. Nat.*), aunque la descripción que ha dado este autor sea demasiado incompleta para servir á resolver la duda. Por otra parte, nos parece diferir bastante del *C. picta* de Wiedmann (*Aus. Zweiflug., Ins.*), para autorisarnos á proponerla como nueva. Tal vez así no ofrezca mas que una variedad occidental."

*Conops brachyrhynchus* Mac., Dipt. Exot., ii, 3, 15, 13.

Long. 5l. ♂. Trompe assez courte, ne dépassant pas le premier article des antennes. Face et front jaunes. Ce dernier brunâtre au milieu. Antennes peu divergentes; premier article testace; deuxième et troisième noirs, d'égale longueur. Thorax et abdomen noirs; deuxième segment de ce dernier à bord postérieur testacé. Pieds testaces; jambes à base jaune et au milieu brun au milieu; tarses bruns. Balanciers testaces. Ailes brunées, bord intérieur brunâtre; première cellule postérieure, discoidale et anale assez claires, nervure terminale de la discoidale oblique. Amérique Septentrionale. M. Bastard.

*Conops flaviceps* Mac., loc. cit., 15, 14.

Long. 3½ l. ♀. Noir. Face et front jaunes; vertex fauve. Antennes; noirs, massue testacee en-dessous; troisième article court. Thorax à épaules et tache contigue en arrière testaces; écusson et metathorax noirs. Abdomen à pétiole très-menu; premier segment noir; deuxième et partie antérieure du troisième fauves; le reste de ce segment, quatrième et cinquième noirs en-dessus, sixième fauve, à duvet d'un gris jaunâtre pâle, bord postérieure des troisième, quatrième et cinquième à duvet semblable. Pieds fauves; hanches noires, jambes à part antérieure jaune, les quatre derniers articles des tarses noirs. Ailes à large bord extérieure brun, termine carrément, une petite tache brune à l'extrémité. De l'Amérique Septentrionale.

*Conops fulvipennis* Mac., loc. cit., 13, 10.

Long. 7 l. ♀. Face jaune; partie supérieure de la carene noire, partie inférieure des joues noires. Front fauve à bord des yeux jaune et bord intermédiaire noire. Antennes testaces. Thorax noir, épaule brunes, deux petites taches de duvet jaunâtre en dedans de ces derniers. Abdomen noir, segments bordés postérieurement de duvet



jaunâtre. Pieds fauves; base des cuisses noires. Ailes: cellule costale d'un jaune pale, un large bord extérieur d'un fauve brunâtre, laissant l'extrémité de la cellule sous-marginale de la première postérieure et de la discoidale, et le bord intérieur hyalin; nervure terminale de la cellule discoidale perpendiculaire à sa base.

*Conops analis* Fab., Syst. Entom., 175, 3.

Antennæ totæ atræ. Caput nigrum, ore late flavo, haustello atro, orbita oculorum postica flavo micante. Thorax niger, utrinque lobo antico linea alba, micante impressa. Abdominus petiolus elongatus ater; facia ante apicem flava. Ultimum segmentum macula magna dorsali flava. Alæ albo-hyalinæ: costa lata nigra. Pedes nigri.

Wied., Aus. Zweif. Ins., ii, p. 237, 5.

Scheitel und Stirn bis zur Fühlerwurzel tief schwarz, wodurch diese Art sich von *costatus* Fabr. leicht unterscheidet, auch ist der Körper überall tiefer schwarz, der obere Rand des Hinterrückens hat nichts Vergoldetes und schimmert kaum an den Seiten ein wenig weisslich messinggelb. An allem Einschnitten des Hinterleibes ist mehr weniger Messinggelbes. Auch die Beine schimmern in gewisser Richtung zum Theil messinggelb. Länge 5 Linien. Aus Südamerika.

*C. costatus* Fab. Wied., Aus. Zweif. Ins., ii, 238, 6.

Fühlerwurzel goldgelblich, drittes Glied unten ocherbraun; Augenhöhlenränder messinggelb. Untergesicht und Stirn honiggelb; Scheitel mit schwarzer Binde, von deren Mitte eine schwarze Strieme zur Fühlerwurzel absteigt und hier gespalten diese Wurzel umfasst. Rückenschild bräunlichschwarz; Schultern vergoldet und neben ihnen nach innen ein vergoldeter Punkt; Seitenränder des Rückenschildes und eine zu den mittleren Hüftgliedern absteigende Strieme vergoldet, auch an dem hintern Rande und den Seiten des Hinterrückens ist etwas Vergoldetes. Das Gelbe an den Rändern der ersten Hinterleibsabschnitte reibt sich entweder leicht ab, oder verschwindet bei schnellem Zusammentrocknen, zuweilen scheint es am zweiten zu fehlen, zuweilen auch sogar am vierten vorhanden; der sechste Abschnitt ist in gewisser Richtung überall gelb. Flügel der Länge nach halb braun, Schwinger gelb, mit schwarzen oder schwarzbraunen Köpfen, Schenkel mehr weniger braun. Länge 5 Linien. Aus Südamerika.

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Fig 1

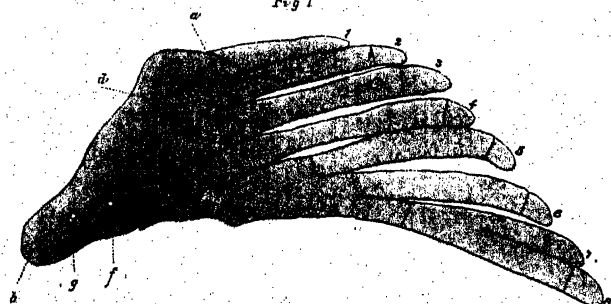


Fig 2



Fig 3





